
Sites of Faunal and Habitat Significance in North East Melbourne

Volume 1—Introduction And Overview

by

Cam Beardsell

(Dunmoochin Biological Surveys)

This is Volume 1 of a six volume study prepared for the North East Regional Organisation of Councils
(NEROC)

Volume 1 has been printed to allow easy access to an overview of the study and an explanation of how the
information has been presented. All six volumes are available on the accompanying CD. All information
concerning the sites of significance can be accessed via this CD, as is explained in the User's Guide on page

xxii.

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VOLUME 2–VOLCANIC PLAINS

MERRI UPLAND VOLCANIC PLAINS (MUVP)

MUVP A. Merri Creek Beveridge to Wallan

- Site 1. Beveridge Rail Reserve–Camoola Swamp
- Site 2. Hernes Swamp
- Site 3. Spring Street Swamp Beveridge

MUVP B. Merri Creek Donnybrook to Beveridge

- Site 4. Bald Hill
- Site 5. Kalkallo–Donnybrook North Rail Reserve

MERRI LOWLAND VOLCANIC PLAINS (MLVP)

MLVP A. Merri Creek Clifton Hill to Campbellfield

- Site 6. Heidelberg Road to Normanby Avenue
- Site 7. McBryde Street–Central Creek–Edwardes Lake Park

MLVP B. Merri Creek Campbellfield

- Site 8. Barry Road Gorge
- Site 9. Cooper Street

MLVP C. Merri Creek Craigieburn to Donnybrook

- Site 10. Craigieburn Grassland
- Site 11. Craigieburn to Donnybrook
- Site 12. O’Herns Road Wetlands

MLVP D. Wollert–Edgars Creek Headwaters

- Site 13. Edgars Creek Headwaters
- Site 14. Summerhill Road

PLENTY LOWLAND VOLCANIC PLAINS (PLVP)

PLVP A. Darebin and Barber Creeks

- Site 15. Fenwick and Surrounds
- Site 16. Plenty River Mernda
- Site 17. Silver Gum Park Woodstock

PLVP B. Epping–South Morang

- Site 18. Epping to Wollert
- Site 19. Mill Park–Blossom Park
- Site 20. Quarry Hill

PLVP C. Darebin Creek Darebin to Bundoora

- Site 21. BMG Quarry–Howy’s
- Site 22. Bundoora Park
- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands

APPENDIXES

- 2.1 Craigieburn Grassland and the proposed ERA
- 2.2 Plenty River Red Gum Protection Zone

VOLUME 3–ALLUVIAL PLAINS

YARRA LOWLAND ALLUVIAL PLAINS (YLAP)

YLAP A. La Trobe University–Mont Park

- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 26. La Trobe Campus Wildlife Reserves–Moat System

YLAP B. Plenty River Lower Reaches

- Site 27. Plenty River Flats

Site 28. Simpson Barracks

YLAP C. Yarra Bend Park

Site 29. Dights Falls

Site 30. Yarra Bend Park

YLAP D. Yarra River Chandler Highway to Plenty River

Site 31. Bailey Billabong–Willsmere Lagoon–Hays

Site 32. Bolin Billabong Bulleen

Site 33. Banyule Flats–Warringal Swamplands

YLAP E. Yarra River Plenty River to Diamond Creek

Site 34. Bonds Road–Birrarung Park–Westerfolds Park

Site 35. Lower Eltham Park–Wingrove Park–Thomsons

PLENTY UPLAND ALLUVIAL PLAINS (PUAP)

PUAP A. Glenvale

Site 36. Mornmoot Lake–Plenty River West Branch

Site 37. Towts Swamp

PUAP B. Plenty River Yan Yean

Site 38. Dunnetts Road Swamp–Plenty River Cades Road

Site 39. Mernda to Yan Yean

VOLUME 4–LOWLAND HILLS

PLENTY LOWLAND HILLS (PLH)

PLH A. Plenty Gorge

Site 40. Yarrambat–Morang Wetlands

Site 41. Kurrak Road

Site 42. Plenty–Janefield

Site 43. Tanunda Wetlands

PLH B. Greensborough

Site 44. Greenhills

Site 45. Yallambie to Greensborough

PLH C. Diamond Creek

Site 46. Diamond Creek

Site 47. Plenty

Site 48. St Helena

PLH D. Eltham

Site 49. Eltham Copper Butterfly Reserves

Site 50. Eltham North

Site 51. Eltham Township

Site 52. Meruka Park

Site 53. Wombat Drive–Piper Crescent Research

Yarra Lowland Hills (YLH)

YLH A. North Warrandyte–Research

Site 54. Pretty Hill–Eltham College

Site 55. Kalbar Road–Research Township

Site 56. Stony Creek–Pigeon Bank–Laughing Waters Creek

YLH B. Yarra River Diamond Creek to Jumping Creek

Site 57. Pettys–Sweeneys–Paddles–Morrison–Glynns

Site 58. Pound Bend–Fourth Hill–The Common–Black Flat

YLH C. Yarra River Jumping Creek to Yering Flats

Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands

Site 60. Round the Bend Cooperative–Maroondah Aqueduct

- Site 61. Sugarloaf Reservoir
- Site 62. Yering Gorge–Yering Flats

YLH D. Watsons Creek Lower Reaches

- Site 63. Henley Road to Watsons Creek
- Site 64. Watsons Creek to Christmas Hills

NILLUMBIK LOWLAND HILLS (NLH)

NLH A. Arthurs Creek Hurstbridge to Strathewen

- Site 65. Arthurs Creek to Strathewen
- Site 66. Hurstbridge to Arthurs Creek

NLH B. Cottles Bridge

- Site 67. Cottles Bridge–Strathewen Road–Shaws Road
- Site 68. Dunmoochin
- Site 69. Pittles Paddock

NLH C. Hurstbridge

- Site 70. Cherry Tree Creek
- Site 71. Haleys Gully Road Red Ironbarks
- Site 72. Hurstbridge to Kangaroo Ground Red Ironbarks
- Site 73. Plenty River–Diamond Creek Link
- Site 74. Wattle Glen to Hurstbridge

NLH D. Diamond Creek Hurstbridge to St Andrews

- Site 75. Cottles Bridge to St Andrews
- Site 76. Red Shirt Gully

NLH E. Panton Hill–Long Gully

- Site 77. Kangaroo Ground–St Andrews Road Red Ironbarks
- Site 78. Long Gully Link

APPENDIXES

- 4.1 Conservation Measures: Melbourne Parks & Waterways management
- 4.2 Morang Wetlands development
- 4.3 Melbourne Parks & Waterways management
- 4.4 The Little Watsons Creek Reservoir/Lower Yarra scheme

VOLUME 5–UPLAND HILLS

NILLUMBIK UPLAND HILLS (NUH)

NUH A. One Tree Hill–Watsons Creek Upper Reaches

- Site 79. Kinglake National Park Link
- Site 80. One Tree Hill–Watsons Creek Link
- Site 81. Watsons Creek–Yarra Ridge

NUH B. St Andrews–Smiths Gully

- Site 82. Diamond Creek Upper Reaches
- Site 83. Smiths Gully Creek
- Site 84. Yow Yow Creek–Wild Dog Creek

NUH C. Strathewen

- Site 85. Arthurs Creek Upper Reaches
- Site 86. Chadds Creek
- Site 87. Hewitts Road

PLENTY UPLAND HILLS (PUH)

PUH A. Doreen–Nutfield–Deep Creek–Running Creek

- Site 88. Deep Creek–Running Creek
- Site 89. La Trobe Downs–Doctors Gully Creek

Site 90. Stewart Ponds Creek

PUH B. Yan Yean Reservoir and Catchment

Site 91. Ridge Road–Sherwin Range Catchment–Reference Area

Site 92. Yan Yean Reservoir and Plantations

PUH C. Upper Plenty–Eden Park

Site 93. Eden Hills

Site 94. Upper Plenty

VOLUME 6–RANGES

HUME RANGES (HR)

HR A. Bruces Creek–Plenty River West Branch Headwaters

Site 95. Bruces Creek–Dry Creek

Site 96. Falls Creek

HR B. Plenty River Headwaters

Site 97. Joey Creek

Site 98. Mount Disappointment–Plenty River Headwaters

Site 99. Toorourrong Reservoir

HR C. Scrubby Creek Headwaters–Sherwin Ranges

Site 100. Scrubby Creek Humevale

KINGLAKE RANGES (KR)

KR A. Kinglake National Park West

Site 101. Arthurs Creek–Chadds Creek Headwaters

Site 102. Running Creek Headwaters

KR B. Kinglake National Park East

Site 103. Diamond Creek Headwaters

Site 104. Steels Creek–Watsons Creek Headwaters

DIRECTORY OF SITES BY FAUNAL SIGNIFICANCE RATING

National

- Site 4. Bald Hill
- Site 10. Craigieburn Grassland
- Site 40. Yarrambat–Morang Wetlands
- Site 42. Plenty–Janefield
- Site 103. Diamond Creek Headwaters

State

- Site 2. Hernes Swamp
- Site 9. Cooper Street
- Site 11. Craigieburn to Donnybrook
- Site 12. O’Herns Road Wetlands
- Site 13. Edgars Creek Headwaters
- Site 14. Summerhill Road
- Site 15. Fenwick and Surrounds
- Site 26. La Trobe Campus Wildlife Reserves–Moat System
- Site 29. Dights Falls
- Site 33. Banyule Flats–Warringal Swamplands
- Site 35. Lower Eltham Park–Wingrove Park–Thomsons
- Site 37. Towts Swamp
- Site 38. Dunnetts Road Swamp–Plenty River Cades Road
- Site 39. Mernda to Yan Yean
- Site 41. Kurrak Road
- Site 44. Greenhills
- Site 46. Diamond Creek
- Site 49. Eltham Copper Butterfly Reserves
- Site 57. Pettys–Sweeneys–Paddles–Morrison’s–Glynn’s
- Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands
- Site 60. Round the Bend Cooperative–Maroondah Aqueduct
- Site 62. Yering Gorge–Yering Flats
- Site 64. Watsons Creek to Christmas Hills
- Site 68. Dunmoochin
- Site 69. Pittles Paddock
- Site 71. Haleys Gully Road Red Ironbarks
- Site 75. Cottlesbridge to St Andrews
- Site 76. Red Shirt Gully
- Site 77. Kangaroo Ground–St Andrews Road Red Ironbarks
- Site 80. One Tree Hill–Watsons Creek Link
- Site 81. Watsons Creek–Yarra Ridge
- Site 83. Smiths Gully Creek
- Site 84. Yow Yow Creek–Wild Dog Creek
- Site 86. Chadds Creek
- Site 91. Ridge Road–Sherwin Range Catchment–Reference Area
- Site 92. Yan Yean Reservoir and Plantations

- Site 95. Bruces Creek–Dry Creek
- Site 97. Joey Creek
- Site 98. Mount Disappointment–Plenty River Headwaters
- Site 99. Toorourrong Reservoir
- Site 100. Scrubby Creek Humevale
- Site 101. Arthurs Creek–Chadds Creek Headwaters
- Site 102. Running Creek Headwaters
- Site 104. Steels Creek–Watsons Creek Headwaters

Regional

- Site 1. Beveridge Rail Reserve–Camoola Swamp
- Site 3. Spring Street Swamp Beveridge
- Site 5. Kalkallo–Donnybrook North Rail Reserve
- Site 6. Heidelberg Road to Normanby Avenue
- Site 7. McBryde Street–Central Creek–Edwardes Lake Park
- Site 8. Barry Road Gorge
- Site 16. Plenty River Mernda
- Site 17. Silver Gum Park Woodstock
- Site 18. Epping to Wollert
- Site 19. Mill Park–Blossom Park
- Site 20. Quarry Hill
- Site 21. BMG Quarry–Howy’s
- Site 22. Bundoora Park
- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands
- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 27. Plenty River Flats
- Site 28. Simpson Barracks
- Site 30. Yarra Bend Park
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock
- Site 32. Bolin Billabong
- Site 34. Bonds Road–Birraring Park–Westerfolds Park
- Site 36. Mornmoot Lake–Plenty River West Branch
- Site 43. Tanunda Wetlands
- Site 45. Yallambie to Greensborough
- Site 47. Plenty
- Site 48. St Helena
- Site 50. Eltham North
- Site 51. Eltham Township
- Site 52. Meruka Park
- Site 53. Wombat Drive–Piper Crescent Research
- Site 54. Pretty Hill–Eltham College
- Site 55. Kalbar Road–Research Township
- Site 56. Stony Creek–Pigeon Bank–Laughing Waters Creek
- Site 58. Pound Bend–Fourth Hill–The Common–Black Flat
- Site 61. Sugarloaf Reservoir
- Site 63. Henley Road to Watsons Creek

- Site 65. Arthurs Creek to Strathewen
- Site 66. Hurstbridge to Arthurs Creek
- Site 67. Cottles Bridge–Strathewen Road–Shaws Road
- Site 70. Cherry Tree Creek
- Site 72. Hurstbridge to Kangaroo Ground Red Ironbarks
- Site 73. Plenty River–Diamond Creek Link
- Site 74. Wattle Glen to Hurstbridge
- Site 78. Long Gully Link
- Site 79. Kinglake National Park Link
- Site 82. Diamond Creek Upper Reaches
- Site 85. Arthurs Creek Upper Reaches
- Site 87. Hewitts Road
- Site 88. Deep Creek–Running Creek
- Site 89. La Trobe Downs–Doctors Gully Creek
- Site 90. Stewart Ponds Creek
- Site 93. Eden Hills
- Site 94. Upper Plenty
- Site 96. Falls Creek

DIRECTORY OF SITES BY HABITAT SIGNIFICANCE RATING

Very High

- Site 2. Hernes Swamp
- Site 4. Bald Hill
- Site 5. Kalkallo–Donnybrook North Rail Reserve
- Site 9. Cooper Street
- Site 10. Craigieburn Grassland
- Site 14. Summerhill Road
- Site 15. Fenwick and Surrounds
- Site 40. Yarrambat–Morang Wetlands
- Site 41. Kurrak Road
- Site 42. Plenty–Janefield
- Site 55. Kalbar Road–Research Township
- Site 56. Stony Creek–Pigeon Bank–Laughing Waters Creek
- Site 62. Yering Gorge–Yering Flats
- Site 68. Dunmoochin
- Site 72. Hurstbridge to Kangaroo Ground Red Ironbarks
- Site 76. Red Shirt Gully
- Site 77. Kangaroo Ground–St Andrews Road Red Ironbarks
- Site 80. One Tree Hill–Watsons Creek Link
- Site 91. Ridge Road–Sherwin Range Catchment–Reference Area
- Site 92. Yan Yean Reservoir and Plantations
- Site 98. Mount Disappointment–Plenty River Headwaters
- Site 103. Diamond Creek Headwaters
- Site 104. Steels Creek–Watsons Creek Headwaters

High

- Site 1.** Beveridge Rail Reserve–Camoola Swamp
- Site 8. Barry Road Gorge
- Site 11. Craigieburn to Donnybrook
- Site 12. O’Herns Road Wetlands
- Site 13. Edgars Creek Headwaters
- Site 22. Bundoora Park
- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 32. Bolin Billabong
- Site 33. Banyule Flats–Warringal Swamplands
- Site 34. Bonds Road–Birraring Park–Westerfolds Park
- Site 38. Dunnetts Road Swamp–Plenty River Cades Road
- Site 39. Mernda to Yan Yean
- Site 43. Tanunda Wetlands
- Site 46. Diamond Creek
- Site 47. Plenty
- Site 48. St Helena
- Site 49. Eltham Copper Butterfly Reserves
- Site 57. Pettys–Sweeneys–Paddles–Morrison’s–Glynns
- Site 58. Pound Bend–Fourth Hill–The Common–Black Flat

- Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands
- Site 60. Round the Bend Cooperative–Maroondah Aqueduct
- Site 64. Watsons Creek to Christmas Hills
- Site 66. Hurstbridge to Arthurs Creek
- Site 69. Pittles Paddock
- Site 75. Cottles Bridge to St Andrews
- Site 78. Long Gully Link
- Site 81. Watsons Creek–Yarra Ridge
- Site 83. Smiths Gully Creek
- Site 84. Yow Yow Creek–Wild Dog Creek
- Site 86. Chadds Creek
- Site 87. Hewitts Road
- Site 97. Joey Creek
- Site 99. Toorourrong Reservoir
- Site 100. Scrubby Creek Humevale
- Site 101. Arthurs Creek–Chadds Creek Headwaters
- Site 102. Running Creek Headwaters

Medium

- Site 3. Spring Street Swamp Beveridge
- Site 6. Heidelberg Road to Normanby Avenue
- Site 7. McBryde Street–Central Creek–Edwardes Lake Park
- Site 16. Plenty River Mernda
- Site 17. Silver Gum Park Woodstock
- Site 18. Epping to Wollert
- Site 19. Mill Park–Blossom Park
- Site 20. Quarry Hill
- Site 21. BMG Quarry–Howy’s
- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands
- Site 26. La Trobe Campus Wildlife Reserves–Moat System
- Site 27. Plenty River Flats
- Site 28. Simpson Barracks
- Site 30. Yarra Bend Park
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock
- Site 35. Lower Eltham Park–Wingrove Park–Thomsons
- Site 36. Mornmoot Lake–Plenty River West Branch
- Site 37. Towts Swamp
- Site 44. Greenhills
- Site 45. Yallambie to Greensborough
- Site 50. Eltham North
- Site 51. Eltham Township
- Site 52. Meruka Park
- Site 53. Wombat Drive–Piper Crescent Research
- Site 54. Pretty Hill–Eltham College
- Site 61. Sugarloaf Reservoir
- Site 63. Henley Road to Watsons Creek

- Site 65. Arthurs Creek to Strathewen
- Site 67. Cottles Bridge–Strathewen Road–Shaws Road
- Site 70. Cherry Tree Creek
- Site 71. Haleys Gully Road Red Ironbarks
- Site 73. Plenty River–Diamond Creek Link
- Site 74. Wattle Glen to Hurstbridge
- Site 79. Kinglake National Park Link
- Site 82. Diamond Creek Upper Reaches
- Site 85. Arthurs Creek Upper Reaches
- Site 88. Deep Creek–Running Creek
- Site 89. La Trobe Downs–Doctors Gully Creek
- Site 90. Stewart Ponds Creek
- Site 93. Eden Hills
- Site 94. Upper Plenty
- Site 95. Bruces Creek–Dry Creek
- Site 96. Falls Creek

Unassessed

- Site 29. Dights Falls

DIRECTORY OF SITES BY MUNICIPALITY

(some sites occur in more than one municipality)

City of Banyule

- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands
- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 27. Plenty River Flats
- Site 28. Simpson Barracks
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock
- Site 32. Bolin Billabong Bulleen
- Site 33. Banyule Flats–Warringal Swamplands
- Site 34. Bonds Road–Birraring Park–Westerfolds Park
- Site 44. Greenhills
- Site 45. Yallambie to Greensborough

City of Boroondara

- Site 29. Dights Falls
- Site 30. Yarra Bend Park
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock
- Site 33. Banyule Flats–Warringal Swamplands

City of Darebin

- Site 6. Heidelberg Road to Normanby Avenue
- Site 7. McBride Street–Central Creek–Edwardes Lake Park
- Site 22. Bundoora Park
- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands
- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 26. La Trobe Campus Wildlife Reserves–Moat System
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock

City of Hume

- Site 3. Spring Street Swamp Beveridge
- Site 5. Kalkallo–Donnybrook North Rail Reserve
- Site 7. McBride Street–Central Creek–Edwardes Lake Park
- Site 8. Barry Road Gorge
- Site 9. Cooper Street
- Site 10. Craigieburn Grassland
- Site 11. Craigieburn to Donnybrook
- Site 94. Upper Plenty
- Site 95. Bruces Creek–Dry Creek

City of Moreland

- Site 6. Heidelberg Road to Normanby Avenue

City of Whittlesea

- Site 1. Beveridge Rail Reserve–Camoola Swamp
- Site 4. Bald Hill
- Site 5. Kalkallo–Donnybrook North Rail Reserve
- Site 8. Barry Road Gorge
- Site 9. Cooper Street
- Site 10. Craigieburn Grassland
- Site 11. Craigieburn to Donnybrook
- Site 12. O’Herns Road Wetlands
- Site 13. Edgars Creek Headwaters
- Site 14. Summerhill Road
- Site 15. Fenwick and Surrounds
- Site 16. Plenty River Mernda
- Site 17. Silver Gum Park Woodstock
- Site 18. Epping to Wollert
- Site 19. Mill Park–Blossom Park
- Site 20. Quarry Hill
- Site 21. BMG Quarry–Howy’s
- Site 36. Mornmoot Lake–Plenty River West Branch
- Site 37. Towts Swamp
- Site 38. Dunnetts Road Swamp–Plenty River Cades Road
- Site 39. Mernda to Yan Yean
- Site 40. Yarrambat–Morang Wetlands
- Site 41. Kurrak Road
- Site 42. Plenty–Janefield
- Site 71. Haleys Gully Road Red Ironbarks
- Site 85. Arthurs Creek Upper Reaches
- Site 91. Ridge Road–Sherwin Range Catchment–Reference Area
- Site 92. Yan Yean Reservoir and Plantations
- Site 93. Eden Hills
- Site 96. Falls Creek
- Site 97. Joey Creek
- Site 98. Mount Disappointment–Plenty River Headwaters
- Site 99. Toorourrong Reservoir
- Site 100. Scrubby Creek Humevale
- Site 101. Arthurs Creek–Chadds Creek Headwaters

City of Yarra

- Site 29. Dights Falls
- Site 30. Yarra Bend Park
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays Paddock

Shire of Mitchell

- Site 1. Beveridge Rail Reserve–Camoola Swamp
- Site 2. Hernes Swamp
- Site 94. Upper Plenty

Site 95. Bruces Creek–Dry Creek

Shire of Nillumbik

Site 40. Yarrambat–Morang Wetlands
 Site 41. Kurrak Road
 Site 42. Plenty–Janefield
 Site 43. Tanunda Wetlands
 Site 46. Diamond Creek
 Site 47. Plenty Red Ironbarks
 Site 48. St Helena
 Site 49. Eltham Copper Butterfly Reserves
 Site 50. Eltham North
 Site 51. Eltham Township
 Site 52. Meruka Park
 Site 53. Wombat Drive–Piper Crescent Research
 Site 54. Pretty Hill–Eltham College
 Site 55. Kalbar Road–Research Township
 Site 56. Stony Creek–Pigeon Bank–Laughing Waters Creek
 Site 57. Pettys–Sweeneys–Paddles–Morrison–Glynn
 Site 58. Pound Bend–Fourth Hill–The Common–Black Flat
 Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands
 Site 60. Round the Bend Cooperative–Maroondah Aqueduct
 Site 61. Sugarloaf Reservoir
 Site 62. Yering Gorge–Yering Flats
 Site 63. Henley Road to Watsons Creek
 Site 64. Watsons Creek to Christmas Hills
 Site 65. Arthurs Creek to Strathewen
 Site 66. Hurstbridge to Arthurs Creek
 Site 67. Cottles Bridge–Strathewen Road–Shaws Road
 Site 68. Dunmoochin
 Site 69. Pittles Paddock
 Site 70. Cherry Tree Creek
 Site 72. Hurstbridge to Kangaroo Ground Red Ironbarks
 Site 73. Plenty River–Diamond Creek Link
 Site 74. Wattle Glen to Hurstbridge
 Site 75. Cottles Bridge to St Andrews
 Site 76. Red Shirt Gully
 Site 77. Kangaroo Ground–St Andrews Road Red Ironbarks
 Site 78. Long Gully Link
 Site 79. Kinglake National Park Link
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 Site 85. Arthurs Creek Upper Reaches

- Site 86. Chadds Creek
- Site 87. Hewitts Road
- Site 88. Deep Creek–Running Creek
- Site 89. La Trobe Downs–Doctors Gully Creek
- Site 90. Stewart Ponds Creek
- Site 101. Arthurs Creek–Chadds Creek Headwaters
- Site 102. Running Creek Headwaters
- Site 103. Diamond Creek Headwaters
- Site 104. Steels Creek–Watsons Creek Headwaters

Shire of Yarra Ranges

- Site 62. Yering Gorge–Yering Flats
- Site 81. Watsons Creek–Yarra Ridge
- Site 104. Steels Creek–Watsons Creek Headwaters

City of Manningham (bordering sections)

- Site 32. Bolin Billabong Bulleen
- Site 33. Banyule Flats–Warringal Swamplands
- Site 34. Bonds Road–Birraring Park–Westerfolds Park
- Site 35. Lower Eltham Park–Wingrove Park–Thomsons
- Site 57. Pettys–Sweeneys–Paddles–Morrison–Glynns
- Site 58. Pound Bend–Fourth Hill–The Common–Black Flat
- Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands

City of Moreland (bordering sections)

- Site 6. Heidelberg Road to Normanby Avenue

Acknowledgements

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Abbreviations

MMBW:	Melbourne Water
ARIER:	Arthur Rylah Institute for Environmental Research.
CAMBA:	China/Australia Migratory Bird Agreement for the protection of migratory birds and their environment.
DITR	Department of Industry, Technology and Resources
EPA:	Environment Protection Authority.
GM:	Greater Melbourne.
IUCN:	International Union for the Conservation of Nature.
JAMBA:	Japan/Australia Migratory Bird Agreement for the protection of migratory birds and their environment.
LCC:	Land Conservation Council of Victoria.
MPE:	Ministry for Planning and Environment.
MPW	Melbourne Parks & Waterways
NEM:	North East Melbourne
NRE	Department of Natural Resources and Environment (including the National Parks Service—NPS); formerly Department of Conservation and Natural Resources (CNR); Department of Conservation and Environment (DCE); and Department of Conservation, Forests and Lands (CFL).
RAMSAR:	Convention of wetlands of international importance, especially as waterfowl habitat
RAOU:	Royal Australasian Ornithologists Union.
SEM	South East Melbourne
UY	Upper Yarra Valley and Dandenong Ranges
WM:	Western Melbourne

NOTE: National Parks Service and Melbourne Parks & Waterways were amalgamated in December 1996. All reference and discussion is to pre-amalgamation.

USER GUIDE

Making the amount of detailed information contained in this large report easily accessible to all its potential users has been greatly assisted by interactive multi-media technology. The CD Rom disk in the back pocket of this volume contains everything necessary for users to find their way quickly to the sections of most interest to themselves. It also includes an electronic version of this volume. The user-friendly Acrobat program chosen to present the report carries with it a comprehensive Help function. The guidelines below are specific to this report and will help you get started.

The User Guide explains how to get started with using the report, how the information in the maps and text has been structured, and ways of navigating through the extensive information available.

Volume 1 outlines the background to the report, describes the geographic areas within NEM, details the methods used in the fieldwork, explains the organisation of and rationale for the sites of significance and puts the case for strategic habitat links and hydrological management strategies for the region. The bibliography is attached to this volume.

All the sites of significance are listed and cross-referenced according to significance rating and shire or municipality.

A printed version of the entire report is held by Nillumbik Shire Council. Copies of volume 1 and extracts from the balance of the report are available.

GETTING STARTED

When you first access the CD, double click on the **Read Me** file according to your computer type. The **Read Me** file has information on how to install the Acrobat Reader software necessary for using the CD-ROM. After you have successfully installed the Acrobat Reader software, open the file called HOME.PDF. The Acrobat Reader application will launch and you will be presented with the opening screen of the CD-ROM. The key words at the bottom of the home page are linked to the text and maps that make up the report. Follow the links on this screen to the sections which interest you.

Take note of the cursor's appearance while using the Acrobat Reader application. A link will be indicated by the cursor changing from a hand to a pointing finger. This indicates that clicking will send you to another section of the CD-ROM. For example try clicking on 'Table of Contents' on the home page. This will bring up a full listing of the contents of the written part of the report. Using the cursor, click on any heading. The detailed information on the selected topic will then be displayed.

Browsing

The CD-ROM has been designed so that you can access the information in a number of ways. The first is simply browsing as if it were a printed book. In this case, you would simply use the Table of Contents as your starting point, and once within the body of the work, use the **Next Page** and **Previous Page** buttons to navigate. The first page of every document has a link back to the [Home Page](#), the [Table of Contents Page](#) and the [Maps Page](#). Use the **First Page** button on the toolbar to get there quickly.

Browsing with Maps

Another way to access the information on the CD-ROM is to browse using the Maps as your guide. From the Maps Page, you are able to click and go to more detailed maps. From these maps, it is possible to click on the site names to access text information regarding the chosen site.

For example if you are interested in a site in the Nillumbik Lowland Hills you follow these steps.

- 1 from the Home Page click on 'maps'—this will take you to a summary map of the study area showing the location of each biophysical zone
- 2 click on the name 'Nillumbik Lowland Hills'

- 3 the next map provides more detail, including the boundaries and the names of each site of significance—click on the site that interests you
- 4 you will see a written description of that site. You can now search for information using the Acrobat Search facility.

Acrobat offers many other ways to navigate within and between maps. Refer to the online Help function for assistance.

All regions and site information can be accessed directly from the maps.

Searching for Information

Most users will have more specific interests and it is for these that the Search function was created. Click on the icon showing binoculars in front of a page and you will be presented with a dialogue box. Type in a key word and click on search. You will be shown a list of all the files containing your item of interest.

example: you typed dieback:

–you are presented with a list of files and the message *found 11 out of 29 documents*

–you can click on each of these in turn and be taken to the relevant file where all references to ‘dieback’ are highlighted

–however you are interested mainly in the Plenty Gorge

–Within the search dialogue box you check the box **proximity** then type ‘dieback’ and ‘Plenty Gorge’

–this time your choices are 7 from 29 documents.

You can refine the search even further by adding extra key words; consult the online help for further detail.

While reading through the sections you have chosen you will find other cross references—e.g. ‘see also site 64’ you can move to the relevant place by typing ‘site 64’ in the search box. Within the file for that site you can search for your particular interest using the **Find** button (the binoculars without a page behind them). Any chosen section can be printed out and retained.

Tools and buttons

The Online Help will explain the use of all the tools and buttons in the tool bar and how to make the most effective use of the program.

KEY INFORMATION PATHWAYS

The information in the report has been structured into six main volumes. Volume 1 provides an overview and volumes 2 to 6 describe in detail findings relevant to each of the 104 sites of significance. These are collected under five biophysical zones.

Volume 2: Volcanic Plains (Sites 1–24)

Volume 3: Alluvial Plains (Sites 25–39)

Volume 4: Lowland Hills (Sites 40–78)

Volume 5: Ipland Hills (Sites 79–94)

Volume 6: Ranges (Sites 95–104)

Within each site description, sites are ranked into three levels of significance for habitat and fauna. Site analysis of biological criteria is presented under Habitat and Faunal Significance. This follows the criteria for selection of sites (Volume 1 Chapter 7). These include species rarity, diversity, representativeness and population density. There are numerous sub-criteria for fauna. Sites are further ranked into Categories (1–3) based on the number of criteria they possess (1 attaining most, 2 attaining some and 3 attaining one). The significance levels with examples of their qualifying criteria include:

Very High—National: high diversity of habitat reference stands, particularly threatened habitats; one of the most viable (natural and intact) and least disturbed stands of a threatened habitat in Victoria; population or species significant in an Australian context such as an endangered species or an extensive population of a vulnerable species

High—State: ERAs or CCAs (see Regional Habitat Link Strategy in Volume 1); high species or regionally significant species diversity or population density; habitat reference stand; population or species significant in a Victorian context (Vulnerable or an extensive population of a Rare species)

Medium—Regional: stand of relatively intact and extensive or otherwise viable habitat; moderate species or regionally significant species diversity or population density; population or species significant in a Greater Melbourne context (Victorian Rare or regionally threatened species); Strategic Habitat Link.

Plant community descriptions are provided in the table of habitat types (Appendix 1.1). Fauna species conservation status, distribution and habitat is provided in the summary of fauna (Appendix 1.3).

Reference grids. These are topographic one minute latitude X longitude grids (2.2 km²) in which data were recorded. They are based on the 1:100 000 NATMAP topographic series. Example. 40^b = North East Melbourne (NEM) reference grid located at latitude 37° 37' south times longitude 145° 06' east. Grids are grouped within sites. The number refers to site 40 (Yarrambat–Morang Wetlands), which covers three 1' grids (40^a, 40^b, 40^c). These are shown on the Sites of Significance maps. Grids provide an area entity to survey and record species, habitat and assemblage parameters such as distribution. They enable quantum analysis of biological significance according to the criteria for selection of sites (Volume 1 Chapter 7).

Flora and fauna significance

Value in this study should be understood as value to conservation. Rarity and abundance are based on empirical evidence—what they have been observed to have been. Intactness is a more subjective measure of condition in relation to others in a comparative frame of reference. Assessment is a combination of rarity, intactness and risk. Aspects of greatest rarity or risk are 'valued' highest.

Habitat listings

Habitats are of four conservation status categories: threatened, disjunct, depleted or secure (see Volume 1 Chapter 9). The numbers 1 to 31 refer to vegetation communities listed in the table of habitat types (Appendix 1.1). For example, 10 is gully woodland. The decimal number refers to habitat types (generally sub-communities and landforms). For example, 10.1 is Manna Gum (creek) gully woodland. This cross-references to habitat descriptions of biophysical zones (introductions to Volumes 2–6) and listings under Habitat Significance and Fauna in the site descriptions.

Stand viability/distribution: quality assessments of stand viability are made under Habitat Significance in the site descriptions. Stand distribution is provided by reference grids under the habitat descriptions of biophysical zones. There are four quality assessment categories:

- a reference stand: one of the most viable and intact stands representative of its habitat known in GM
- b relatively intact and extensive stand or lesser stand that supports a rare or threatened species or significant population
- c partially intact or small stand
- d degraded, remnant or establishing stand

Faunal listings

Assessment follows the key classification criteria for selection of sites (Volume 1 Chapter 7). Listings follow the taxonomic order provided in the summary of fauna (Appendix 1.3). The pathway is through a dual lettering system. The first letter refers to the criteria level. These are:

- B RARITY:** Rare or Threatened Fauna
- C DIVERSITY:** Species/Assemblage Richness

- D REPRESENTATIVENESS:** Faunal Assemblages
E REPRESENTATIVENESS: Regionally Significant Species
F POPULATION DENSITY: Viability and Abundance

The second letter provides the sub-criteria parameter. For example, **Ba** refers to occurrence of Victorian endangered species, **Cb** refers to diversity of waterbirds, **Df** refers to representativeness of butterfly assemblages, **Ec** refers to representativeness of regionally vulnerable species and **Fg** refers to population density of rare/restricted colonial fauna.

Victorian rare or threatened species (Criterion **B**). The conservation status of species at risk in Victoria follows NRE (1996) for plants and CNR (1995) for animals. This provides a statewide context for significance of site occurrences of species. Three levels are applied: endangered; vulnerable and rare; depleted, insufficiently known or potentially threatened. These are referred to as VROT species with endangered and vulnerable being threatened.

Regionally significant species (Criterion **E**). The conservation status of plant and animal species at risk in the Greater Melbourne and Port Phillip Catchment (GM) was determined from extensive review of their distribution, abundance and rarity. This provides a regional context for significance of site occurrences of species. Five levels are applied: regionally endangered (R1), regionally vulnerable (R2), regionally rare (R3), regionally depleted (R4) and regionally restricted (R5).

Landforms and other physical parameters: these are discussed under zone introductions and management unit and site descriptions.

SUMMARY

This report identifies and describes 104 sites of faunal and habitat significance in North East Melbourne (NEM), one of four geographic regions which comprise Greater Melbourne.

North East Melbourne has both a diverse and compact physical environment. It occupies an area of 1000 km² and in comparison to much larger surveyed regions of Victoria (e.g. East Gippsland) contains an equivalent faunal diversity. This high diversity is due to:

- the extensive tracts of volcanic and alluvial plains which support grassland and woodland habitats and a high diversity of wetland habitats;
- an intervening band of dry and valley sclerophyll forest habitats in the foothills; and
- the proximity of extensive areas of uncleared wet and damp sclerophyll forest habitats in the Great Dividing Range.

Underlying these variations in habitat are differing geologies, altitudes and a dramatic rainfall/climatic gradient, the extremities of which range from 600–1200 mm mean annual rainfall over a distance of about 20 km from Craigieburn to Mt Disappointment.

Aim

The study purpose was the pursuit of information and increased understanding of ecological management practices that best enhance flora and fauna conservation. The study premise is that scientific knowledge is necessary for implementing sound conservation management. The report provides a strategic overview of the conservation values of flora and fauna of North East Melbourne. This involves scientific evaluation of nature conservation values to complement land-use planning and development decisions. The study is intended to provide a guide to subsequent more specific and detailed investigations required for particular proposals or management plans.

Background

The survey period spanned eleven years. Zoological survey was undertaken mainly from 1986 to 1993. Vegetation community and rare or threatened plant species survey has been undertaken since 1993. Companion botanical studies to the fauna study are planned (see the Habitats of North East Melbourne in Appendix 1.1).

Preparation of texts was undertaken from late 1991 to early 1997 and evolved through several editorial stages. Each was a stepping stone to weld new concepts and improve systematic presentation. During the final stage, from September 1996 to April 1997, layout and information pathways were set up for CD ROM and analyses and descriptions of flora and habitats were integrated with fauna. The study is original and innovative in the degree and scope of scientific research and the level of application for management, planning and interactive media.

Ecological fields are constantly changing due largely to impact from the human environment. As the survey unfolded and new information was added to the data analysis, a clearer picture emerged of the local conservation status of species. Several have become rarer (e.g. Swift Parrot) while others have become more common (e.g. Rainbow Lorikeet). Almost 50 000 faunal species records and 30 000 flora species records were gathered and analysed. There are other smaller data sets including reference grids and plant communities. The immense scope of information presented and the dynamic nature of systems make it inevitable that some inconsistencies will appear in the report. Any anomalies will be corrected in a second edition.

HOW THE INFORMATION IS PRESENTED

A considerable range of information is provided and cross-linked. The reader should refer to the information summaries in Volume 1, the Digitised Maps (on CD) and the User Guide in this volume for help in finding information of particular interest.

Maps

These show the sites of faunal significance, sites of habitat significance and regional habitat links. They provide a window to information on biological significance. The maps have been digitised for interactive use in the CD ROM version of the report. At the scale of presentation, the accuracy of lines is general. There are unsurveyed areas of potential significance which are not shown in sites of significance. These are provided on the maps against a dotted background in a management unit. It should not be assumed that these areas are of low significance.

Tables and appendixes

The two main tables provided are the habitat types of North East Melbourne (Appendix 1.1) and the summary of fauna recorded from North East Melbourne (Appendix 1.3). These are building blocks to information layers of the report. Other appendixes attached to Volumes 2 and 4 discuss some specific management issues in greater detail than is offered by the general layout of sites.

Sites of significance

The level of significance has been assigned to sites based on the satisfaction of a series of criteria relating to the rareness and threatened status of species and habitats, the relative population size, viability and diversity.

There are 104 sites. These provide analysis and discussion of site specific information on habitats, species and conservation management (Volumes 2–6). Each of the volumes describes a biophysical zone: volcanic plains, alluvial plains, lowland hills, upland hills and ranges. At the beginning of each volume, summaries of key biological attributes and detailed information on habitats and the physical environment including landforms is presented. Sites are grouped into management units within each volume. These provide additional descriptive information applicable to local catchment management.

Significant species

Certain species that naturally occur in NEM are of particular concern. These are listed below with their conservation status in Victoria, based on the classification of Baker-Gabb (1991). Vagrant species are not included in this analysis.

Four species are endangered, seven species are vulnerable, twenty species are rare, nine species are insufficiently known and four species are known to form restricted colonial breeding or roosting sites (See Appendix 1.1).

Five rare or threatened species of fish and a tortoise have been introduced.

Rare or threatened species in Victoria whose range or population in terms of survey sightings in NEM constitutes >50% of that for GM include: Lewin's Rail, Blue-billed Duck, Grey Goshawk, Barking Owl, Masked Owl, Sooty Owl, Red-tailed Black-Cockatoo, Swift Parrot, Regent Honeyeater, Spot-tailed Quoll, Brush-tailed Phascogale, Common Dunnart, Eastern Horseshoe-Bat, Common Bent-wing Bat, Large-footed Myotis, Eastern Broad-nosed Bat, Mountain Dragon, Tree Goanna, Glossy Grass Skink, Tasmanian Mudfish, Australian Grayling, Rare White-spot Skipper, Genoveva Azure, Small Ant-blue, Large Ant-blue, Eltham Copper, Yellow-spot Jewel, Ictinus Blue and Icilius Blue.

Habitats should be protected for all species that are regionally threatened, rare or restricted and the major threatening processes that are contributing to their decline need to be addressed.

Volume 1 Regional overview

This provides background information on physical environment, habitats, study methodology, site assessment criteria, conservation strategies and bibliography.

Habitat Link and Hydrological Strategies

The central philosophy of these strategies is to preserve and enhance indigenous species and communities. They provide an overview to conservation management issues. This is best achieved through improvement of habitat links and protection of waterways.

KEY FINDINGS AND RECOMMENDATIONS

The most common deficiencies identified for areas outside the publicly owned biological reserve system were continued decline of grasslands and grassy woodlands, degradation of waterways and severance of habitat links.

The key recommendations of the study are:

- protection of Victorian Rare or Threatened Species and habitat reference stands;
- continuation of effective conservation management in the biological reserves of North East Melbourne;
- incorporation of the Craigieburn Grassland and its nationally significant flora and fauna assemblages into a biological reserve (sites 10 and 12);
- incorporation of the Yering Backswamp into a biological reserve (site 62);
- establishment of the Yarra–Kinglake Nature Conservation Link (sites 63, 64 and 79–81);
- preservation of the unique flora and landforms of the Plenty Gorge (sites 16 and 40–43)
- protection of ecosystems, notably Ecological Reference Areas (ERAs) and particularly rainforest and wet forest of Plenty River headwaters and heaths and heathy woodland of Broad Gully in Kinglake National Park;
- protection of threatened species/habitats, notably Critical Conservation Areas (CCAs) and particularly endangered species for which NEM is critical for survival, such as the Southern Lined Earless Dragon, Small Ant-blue Butterfly, Eltham Copper Butterfly and Charming, Crimson and Rosella Spider-orchids;
- progressive enhancement of Strategic Habitat Links.

Environmental threats to flora and fauna in North East Melbourne

These fall into five main groups:

- 1 *Habitat fragmentation*: loss of habitat links due to clearing of native vegetation for agricultural/urban land; eucalyptus dieback;
- 2 *Habitat quality decline*: from poor catchment management; water pollution and eutrophication (particularly blue-green algae) and stream salination, nutrification and siltation; contaminants in residential and farmland runoff and industrial effluent that include heavy metals, pesticides and herbicides; riverbank erosion/degradation and gully/hill-slope erosion due to vegetation removal by rabbits, land clearing and livestock grazing; native substrate removal (particularly rocks);
- 3 *Urban/human disturbance*: residential development impact (including domestic pets, particularly cats and dogs); recreational activity pressure including horse riding; fire;
- 4 *Declining native species populations*: caused by active extinction processes resulting from habitat loss, alteration or disturbance and ecosystem imbalance in bushland refugias (e.g. domination of edge/fragmentation species such as Bell Miners over bushland species such as foliage insectivores)
- 5 *Alien species impact*: weed competition and rabbit grazing of native flora; fox predation of native fauna and the spread of berries of woody weeds; cat predation of native fauna; European Wasp predation of insects; resource competitors or predators of native fauna. The latter includes Common Mynas, Common Starlings and Honey Bees for tree hollows, Blackbirds, rabbits and Black Rats on the ground and Brown Trout, European Carp, Goldfish, Roach and Mosquito Fish in waterways.

Conservation management measures for flora and fauna in North East Melbourne

Recommended conservation management measures fall into ten main groups:

- 1 *Survey and map* flora and fauna communities, their rarity and intactness on private and public land; identify operative threatening processes and necessary conservation measures.
- 2 *Devise environmental management plans* to conserve and enhance rare or threatened or otherwise significant flora and fauna species and stands of vegetation; assess management risks and conduct ongoing research and monitoring programs to provide feedback on management efficiency or identify information gaps (e.g. invertebrate studies).
- 3 *Design regional conservation strategies* for habitat links and stream protection; implement government nature conservation policies (e.g. Flora and Fauna Guarantee to protect threatened species, international migratory bird agreements etc.).
- 4 *Enhance habitat links* to ameliorate the effects of habitat fragmentation and improve faunal corridors.
- 5 *Revegetate native flora communities* by propagation/planting of indigenous species and natural regeneration.
- 6 *Establish conservation parks and biological reserves* and instigate rare or threatened plant protection programs.
- 7 *Conserve other significant bushland on private land*: assess habitation (including domestic pet) effects; provide environmental impact assessments for development proposals that conflict with biological values; formulate measures to protect indigenous habitat including rock substrates on the volcanic plains and reverse the advance of rural tree decline.
- 8 *Undertake land and stream protection works*: weed, vermin, erosion, salination and pollution control; monitor instream water quality; fence streams and gullies from livestock grazing; improve urban and rural land-uses to reduce the levels of contaminated water output into streams; construct hard-rubbish traps and sediment/nutrient settling ponds at urban pollution point sources.
- 9 *Promote community education and involvement* in land protection, nature conservation and environmental interpretation programs such as LandCare, Land for Wildlife and friends support groups.
- 10 *Obtain adequate resources and funding* for 1–9; coordinate labour resources in the local community and financial resources at local, state and federal government levels; rectify threatening processes by implementing local (e.g. tree planting, weed eradication) and regional conservation programs (e.g. salination control, threatened species recovery plans).

NEXT STEPS

This report is a first edition. Until the end of 1997, readers are invited to forward comments on inconsistencies or errors in content to Nillumbik Shire Council for incorporation into future editions. Feedback on further multi-media applications is particularly welcomed. It is planned that proofing and final editing will be completed for a second edition in 1998. This could also include summaries for each volume of threatening processes and conservation measures and a common and scientific name plant list.

Fundamental to this study is that the fauna survey data be entered into a regional information system. Subject to funding, the raw data will be made available as an addendum (Volume 7) to the second edition. This information is vital for management bodies and conservation groups. Funding is also needed for a complete flora survey of NEM.

The 1986 to 1996 survey database closed with the summer of 1996–97. A new survey period has begun. Follow-up survey and analysis should be provided in a review in five to ten years time. Readers are invited to forward updates on management and species records to the Nillumbik Shire Council for incorporation into the review.

Cam Beardsell, 4 April 1997

CHAPTER 1

INTRODUCTION

This report is the result of an initiative, by the North East Regional Organisation of Councils (NEROC) and the National Estate, to identify sites of faunal and faunal habitat significance in North East Melbourne (NEM). A steering committee composed of representatives from the five councils of NEROC and from the Department of Natural Resources and Environment (NRE, then CNR) was set up to coordinate the study.

Most of the original native vegetation of Greater Melbourne (GM—see Maps 1 and 2), has been cleared or substantially modified since European settlement. Over recent decades there have been rapid land-use changes associated with expanding urban and industrial development and intensification of agricultural practices (e.g. subdivision of broad-acre farms into small farmlets). This has escalated the rate of decline and fragmentation in the range and diversity of faunal species and their habitats.

Within the urban area over 98% of the land has already been lost to development and much of that remaining is of diminishing biological value. Until recently, scant regard has been given to nature conservation in the urban area. Because extensive surveys of the distribution of fauna and studies to identify sites of significance have never before been conducted in Victoria's urban growth areas or in grasslands and grassy woodlands (the vast majority of both occurring on private land), new methodologies have been developed for field survey and analysis and for site selection criteria. They are based on the rarity, diversity, and representativeness of the fauna and on the intactness, extent and connectivity of their habitats.

Faunal significance is the 'value' placed upon wildlife species and populations, and their habitats. There has been a growing consensus, as reflected in Victorian legislation (e.g. *Wildlife Act 1975*, *National Parks Act 1975*, *Flora and Fauna Guarantee Act 1988*) that wildlife populations should be conserved. The underlying premise to recommendations arising from this study is that fauna and faunal habitat values should be maintained and enhanced wherever possible.

The fauna of each site of significance was identified after intensive field surveys, searches of literature and museum records, incorporation of data from the Atlas of Victorian Wildlife (NRE) and interviews with local naturalists. The purpose of this report is to provide accurate and comprehensive information about sites of faunal significance and the species of native terrestrial vertebrates (including the Platypus and Water Rat) that require conservation management. This information will assist planners in state and local government agencies and landowners in assessing future land-use and development.

OBJECTIVES

The objectives of the study were to:

- undertake a broad-scale survey for birds, mammals, reptiles, frogs and freshwater fish in all sizeable stands (usually >50 ha and in the outer section of NEM) and smaller stands (usually in the urban area) of natural habitat and artificial landforms supporting native flora and fauna species in the North East Melbourne Study Area (see Map 1 for location; Maps 2 & 3 are inside the back cover);
- identify the fauna and faunal habitats and assess the faunal and habitat significance of sites on a national, state and regional level using defined selection criteria (see Chapter 7)
- identify habitat links and propose a regional habitat link strategy so as to maintain faunal movements and site connectivity (see Chapter 11)

Map 1 The Location of the Study Area in North East Melbourne

- identify fauna that are threatened in the state or threatened, rare or restricted within GM and NEM (these are listed under each site);
- identify processes threatening fauna and faunal habitats (see individual sites and also Chapter 8; and
- outline conservation measures for fauna and faunal habitats (see individual sites).

SPECIES FOUND

Populations of 322 species of native terrestrial vertebrates, 14 species of native freshwater fish and 55 species of native butterflies (excluding 8 species of non-breeding inland vagrants or self-introduced migrants) were recorded in NEM during the survey period (1986–96). Each species has its own distribution, abundance and habitat requirements. In some instances these are not well understood. It should not be inferred that areas not identified have no faunal significance. Likewise, it should not be inferred that a particular block within a site (however high the potential) will contain all of the faunal values of the larger site. Loss or deterioration of habitat, or loss of connectivity in the block may fragment or reduce the viability of faunal populations within the site (e.g. by the loss of a key habitat component or link).

STUDY AREA

North East Melbourne lies between the Hume Freeway, the Yarra River (and areas of contiguous public land to the south) and the Great Dividing Range (Figure 1). The eastern boundary is marked by the Watsons Creek catchment boundary (Yarra Ridge). It contains all of the cities of Banyule, Darebin and Whittlesea and the shire of Nillumbik and bordering sections of the cities of Boroondara, Hume, Moreland and Yarra and the shires of Mitchell and Yarra Ranges.

CHAPTER 2

PHYSICAL FEATURES OF NORTH EAST MELBOURNE

PHYSIOGRAPHY AND LANDFORMS

North East Melbourne is contained in the Eastern Uplands physiographic region (Hills 1975). The Western Volcanic Plains begin at Moonee Ponds Creek about 10 km to the west of NEM. Along with Port Phillip Bay, they form the Port Phillip Sunkland and are part of the central lowlands geomorphic region of the southern lowlands (LCC 1985). According to Hills (1975), the Eastern Uplands in NEM is composed of two physiographic units (Kinglake Plateau and Nillumbik Terrain). Usage of the term 'Nillumbik Terrain' is now open to question. Within this study it is replaced by plains and hills and the term 'Kinglake Plateau' is replaced by ranges.

The plains are composed of volcanic and alluvial plains. The hills are composed of lowland and upland hills. These and the ranges discretely separate on the basis of biotic and physical characteristics and general management issues. To integrate specific management issues with physical and biotic features, these have been further subdivided into twelve biophysical zones (see Maps 1 and 2 and Chapter 3).

The lowlands of NEM rise gently northwards from low-lying coastal alluvial plains and volcanic plains near Melbourne. The gradient increases and the topography becomes undulating as volcanic cones and outcropping sedimentary and granitic hills appear on the landscape at 160 m to 200 m elevation (a line from Craigieburn through Woodstock to Whittlesea). This line marks the boundary between the lowlands and uplands. The major streams enter deep gorges as they descend from the upland hills and plains to the lowland hills and plains of NEM. Extensive alluvial plains at Yan Yean lie upstream of the Plenty Gorge on the Plenty River. The upland volcanic plains of Merri Creek rise steadily northwards to about 300 m at the foot of the Great Dividing Range near Wallan, on the northern perimeter of NEM.

The lowland alluvial plains rise to between 40 m and 80 m elevation (a line between La Trobe University and Eltham). The rising foothills to the north-east are at first gently rounded, but become more steeply dissected at about 200 m (a line from Doreen through Smiths Gully to Christmas Hills). This line marks the boundary between the lowlands and uplands. The watercourses change their morphology from fast-moving mountain streams to meandering coastal streams. Extensive alluvial plains at Yarra Glen lie upstream of the Yering and Warrandyte gorges on the Yarra River. The upland hills rise further until they approach the foot of the ranges at about 300 m elevation. The ranges contain the mountain slopes and plateaus of the Great Dividing Range and rise from 300 m to 794 m elevation at Mt Disappointment, on the northern perimeter of NEM.

Eastern Uplands

This region comprises two physiographic units, the ranges (300–794 m elevation) and the plains/hills (5–300 m elevation). The ranges occur along the Great Dividing Range. The plains/hills (previously referred to as the Nillumbik Terrain) are a maturely dissected land surface of relatively low relief stretching from the southern escarpment of the Kinglake Ranges to the Dandenong Ranges and then to Port Phillip Bay. The unit forms a shelf lying between the Great Dividing Range and the basin containing the volcanic plains to the west of Melbourne and drowned lower parts of the lava plains which became Port Phillip Bay, part of the Port Phillip Sunkland (Hills 1975).

The physiographic boundary between the Port Phillip Sunkland of Western Melbourne and the plains/hills of NEM is approximately along the Old Sydney Road in a line from Pretty Sally to Gellibrand Hill and south along Moonee Ponds Creek to the top of Port Phillip Bay. The uplifted and undulating hills of NEM occur east of the Plenty River and north of the Yarra Fault. These hills were formerly known as the

Yarra Plateau. East and south of the Yarra Plateau/Yarra Fault, a low-lying area covering the flats between Yarra Glen and Healesville and from the foot of Mt Dandenong between Croydon and Bayswater to Frankston was known as the Croydon Sunkland. This is a downfaulted section of the old Nillumbik Terrain. To the south of this, in a line between Mt Dandenong and Frankston, lies the Gippsland Coastal Plains.

The Ranges

The ranges consist of two biophysical zones (see Chapter 3), the Kinglake Ranges and Hume Ranges of the Great Dividing Range. The Kinglake Ranges contain the headwaters of the Diamond, Arthurs, Watsons and Steels creeks. The Hume Ranges contain the headwaters of the Plenty River East and West Branches (and tributaries including Bruces and Scrubby creeks) and part of the headwaters of Merri Creek.

The Hills and Plains

These comprise lowland hills (ridgelines <200 m elevation), upland hills (ridgelines >200 m elevation), volcanic plains and alluvial plains. In this study the hills and plains have been subdivided into ten biophysical zones: Nillumbik Upland Hills and Plenty Upland Hills; Plenty Lowland Hills, Yarra Lowland Hills and Nillumbik Lowland Hills; Yarra Alluvial Plains and Plenty Alluvial Plains; and Merri Upland Volcanic Plains, Merri Lowland Volcanic Plains and Plenty Lowland Volcanic Plains.

The division between the lowland and upland hills is based on a combination of biotic features and physical features such as elevation. The biota of the upland hills has more features in common with the ranges than the plains. The biota of the lowland hills has more features in common with the plains than the ranges.

GEOLOGY AND GEOMORPHOLOGY

The hills and ranges of NEM are composed of older, Palaeozoic Era (i.e. Silurian and Devonian) sedimentary and granitic rock types. The landscape of the plains is composed of younger, Cainozoic Era (i.e. Tertiary and Quaternary) basalt and sedimentary rock types. The hills are predominantly Silurian Period (446 to 416 million years BP*) and the ranges are predominantly Devonian Period (416 to 367 million years BP). Mt Disappointment, Quarry Hill and smaller granitic outcrops arose from igneous intrusion in the upper Devonian Period (about 380 million years BP).

During the Devonian and Silurian Periods the ranges and hills of NEM were part of a marine sedimentary basin. The ranges were uplifted during the Cretaceous Period (140 to 65 million years BP). The hills were uplifted and subsequently worn down by erosion in a later period (believed to be within the last 2 million years—Quaternary Period). The uplifting of the ranges established the major drainage systems. The uplifting of the hills established the present position of these systems. The land surface features of the hills are lower and younger than the ranges. The Newer Volcanics occupy the central, low-lying section of the plains of Melbourne and have separated the eastern section in NEM from the western section around Sunbury in Western Melbourne. Sedimentary hills outcropping the volcanic plains between Craigieburn and Donnybrook (e.g. Summer Hill and Woody Hill) and the sedimentary exposures in the deeply incised sections of the Merri Creek gorge at Barry Road illustrate this formation.

Complex folding of the hills has led to their undulating character and a local diversity of Silurian sedimentary rock types and landforms. There is a strong north–south pattern of ridges and valleys which gives a diverse east–west cross-section of landforms and geological/soil types. The folding has also produced a regular pattern of syncline and anticline formation. Where anticlines occur on the ridges the younger overlying sandstone has usually been eroded away to expose the older underlying siltstone and mudstone. When the ridges contain synclines, the sandstone has usually remained. The different geological types often support different soil and vegetation types.

Younger landscape units in the lowlands of NEM include small sand-plain outcrops of early Tertiary (about 50 million years BP) river alluvium. These usually accompany minor occurrences of late Tertiary (5 to 2 million years BP) Older Volcanics (e.g. Kangaroo Ground hill). Late Tertiary alluvium stranded coastal

sand-crests from a marine transgression occur at Heidelberg. Non-marine sand ridges occur on the Yarra Fault at Yering. These are Quaternary high level deposits from drainage systems and swamps of the Yarra River.

Lava flows covered the plains and low hills to the north and west of Melbourne from the end of the Tertiary and through the Quaternary Periods, 5 to 1 million years BP (Rosengren 1986). The Port Phillip Sunkland subsided relatively recently, between 2 million and 1 million years BP in the early Quaternary Period. This formed Port Phillip Bay and the surrounding coastal plains. The origin of late Quaternary to Recent depositional surfaces are alluvial (streams), lacustrine (swamps), aeolian (wind), fluvial (water) and colluvial (deposition on lower slopes from higher slopes resulting from gravitational and water movement).

For further information refer to the Melbourne 1:250 000 geological map sheet. Generalisations in type have been made (like the soils). The maps are highly useful and correlate well with ecological distributions (e.g. in the hills, box-stringybark woodland dominated by Red Box with wallaby-grass and low shrub understorey occurs on Silurian mudstone while that dominated by Yellow Box with Kangaroo Grass and tall shrub understorey occurs on Silurian sandstone). The types take on a far higher diversity than described. The maps are equally generalised and usually do not show localised occurrences. Summarised landform and geological descriptions are provided at the beginnings of Volumes 2 to 6.

SOILS

The soil classification system used in the description of each biophysical zone has been adapted from Northcote (1962), Jeffery (1981), LCC (1985) and MMBW (1985). The distribution of soils correlates with geology and landforms. In combination with rainfall and elevation, these correlate with flora and fauna distributions and biophysical zone boundaries. Knowledge of soils proved essential for predicting search areas for reptiles. Observations of soil types were from artificial exposures created by earthworks such as mines, road cuttings and dam excavations and from natural exposures such as creek banks and gullies. The soils of the ranges and hills are sedimentary or less often, granitic in origin. Those of the plains are derived from Quaternary basalt and Recent sedimentary deposits. Soil characterisation was often difficult, and inter-grades were frequently encountered, particularly between gradational and duplex types in the hills and the deep gradational soils in the ranges which often have a 'uniform' character. The types take on a higher diversity than described.

Uniform soils are those with profiles exhibiting little texture change with depth. Gradational soils exhibit no sharp changes in texture, but gradually become more clayey with depth. Duplex soils are those exhibiting a sudden change in texture at about 30 cm depth between the A (topsoil) and B (subsoil) horizons, the subsoil being much more clayey than the topsoil. The colour of duplex soils refers to the dominant clays of the subsoil horizon. Summarised soil descriptions are provided at the beginnings of Volumes 2 to 6.

HYDROLOGY

Watercourses

The Yarra River rises in the Upper Yarra Ranges to the east of Warburton. The other five major drainage systems of NEM rise in the Kinglake and Hume Ranges. Two systems are perennial (Yarra and Plenty rivers) as they have extensive, high-rainfall highland catchments. The others are narrow, shallow and intermittent (Merri Creek, Darebin Creek, Diamond-Arthurs Creek and Watsons Creek) as they rise in lower rainfall areas. A few ephemeral creeks rising in local, low-rainfall catchments of the volcanic plains (notably Darebin Creek and Edgars Creek) are interspersed across the plains. The Yarra River downstream of the Diamond Creek is slow-moving, containing steep banks and deep (>8 m) pools with silt substrates. Extensive terraces occur along the broad floodplain. The laterally meandering course of the river is actively forming an abandoned system of shallow, ox-bow billabongs and back swamps. These are inundated during floods, but cut off from the mainstream during normal and low flow periods. Upstream of the Diamond Creek, the Yarra River is swift flowing and entrenching, containing cliffs, islands and rapids.

Less than 20% of the Plenty River catchment is forested, with the majority being upstream of Toorourrong Reservoir (McKenzie & O'Connor 1989). This area affords the most pristine river conditions in

NEM (e.g. native riparian vegetation, clear flowing water and a substrate of cobble, sand, gravel and logs). Downstream of the reservoir the river forms extensive floodplains with slow-flowing water. The floodplains form cleared farmland and are degraded. Sections of the stream are almost totally lacking in native riparian or instream vegetation, apart from remnant stands of paperbark.

Major watercourses on the volcanic plains have been displaced to follow lava flow boundaries while minor streams have been heavily disrupted. The Plenty River has been displaced in an easterly direction and the gorge section flows along the boundary of the volcanic plains and sedimentary foothills. Its former course was near that of the present Darebin Creek. The watercourses on the volcanic plains have cut deeply incised gorges along their mid-reaches where they rapidly descend from the uplands to the lowland coastal plains (see Physiography and Landforms in this chapter). The gorges contain a series of slow-moving, deep-water pools (up to 6 m deep) and sections of shallow runs supporting riffles and rapids which carry fast-moving water after runoff rains. The meandering lower (urban) sections upstream of the Yarra River are characterised by slower moving water and deep pools. These are highly degraded, supporting predominantly alien vegetation.

Waterbodies

Most of the swamps in NEM are associated with the floodplains of the middle and lower reaches of the major drainage systems. These areas lie along the Plenty River between Yan Yean and Glenvale and in the Lower Yarra between Heidelberg and Templestowe and Middle Yarra upstream and downstream of Yering Gorge. The headwaters of the Plenty River form part of Melbourne's water catchments and have been dammed for water storages (Yan Yean and Toorourrong reservoirs). The headwaters of Wallaby Creek has been diverted from the northern side of the divide into Toorourrong Reservoir. There is an extensive shallow freshwater marsh where the Plenty River enters Toorourrong Reservoir. The floodplain of the Plenty River East Branch at the inlet to the reservoir has formed a silt delta which contains numerous small islands surrounded by meandering anabranches of the river.

Freshwater meadows are normally inundated for less than four months of the year and are less than 0.3 m deep when full (Corrick 1982). These wetlands are the most common type remaining on the plains of NEM but most have been heavily modified. Shallow freshwater marshes are normally inundated for six to twelve months of the year and support an average depth not exceeding 1 m when full. Deep freshwater marshes are normally permanent and support an average depth exceeding 1 m when full. No natural deep freshwater marshes remain in NEM. Permanent shallow (<3 m) open water in the form of artificial impoundments, farm dams and quarries is the major waterbody type in NEM. Permanent deep (>3 m) open water occurs at Sugarloaf, Yan Yean and Toorourrong Reservoirs.

One natural shallow freshwater marsh exceeding 2 ha remains in NEM (Banyule Swamp). Four significant semi-natural (containing raised levee banks) shallow freshwater marshes are Towts Swamp Glenvale, Dunnetts Road Swamp Yan Yean, O'Herns Road Swamp Craigieburn and Wilton Vale Marsh in Plenty Gorge Park. The former two occur along the floodplain of the middle Plenty River. During floods a large body of water backs up from the head of the Plenty Gorge, inundating the marshes. An extensive shallow freshwater marsh system formerly occurred around the junction of Bruces Creek, Plenty River West Branch and Scrubby Creek near Whittlesea. Similarly, an extensive marsh system occurred on the Yering Flats of the Middle Yarra, upstream of Yering Gorge.

Hernes Swamp near Wallan is a freshwater meadow which arose from lava flows blocking several drainage lines. It lies in an extensive low-lying alluvial/volcanic plain which is land-locked by lines of hills to the east and west and the ranges to the north. Before being drained, the swamp would have been an extensive shallow freshwater marsh. Freshwater meadows in depressions at stony rise aprons and gilgais are usually shallow and fill irregularly. A freshwater meadow in the Edgars Creek headwaters formed in a hot spring thermal crater depression. The Spring Street Beveridge Swamp is a permanent freshwater meadow fed from groundwater springs.

CLIMATE

Tertiary uplift of the Otway and Brisbane Ranges has placed the western volcanic plains of GM under a 'winter rainshadow' zone by blocking prevailing south-westerly rain-laden winds (LCC 1985). This rainshadow zone extends into the western section of NEM on the Merri Plains and seasonal rainfall is uniformly distributed in this area. This gives the Merri Plains an affinity with coastal plain and inland tableland areas of eastern Victoria and south-eastern New South Wales. The low mean annual rainfall of the rainshadow area also provides climatic, floristic and faunal affinities with north-western Victoria (Emison *et al.* 1987, Bennett *et al.* 1990).

The Kilmore Gap in the Great Dividing Range and the Western Volcanic Plains rainshadow influences the low rainfall pattern of the Merri Upland and Lowland Volcanic Plains, Plenty Lowland Volcanic Plains and western sections of the Plenty Lowland Hills such as the Plenty Gorge.

The wet ranges and lower rainfall foothills contain a dominating winter rainfall pattern. The mean annual rainfall range in NEM is from 600 mm at Craigieburn to over 1300 mm at the top of the Great Divide between Mount Disappointment and Kinglake West (local rainfall estimates and Bureau of Meteorology data). The mean monthly rainfall at bureau stations relevant to NEM is provided in Table 2.1.

Rainfall in the north of NEM increases sharply with elevation on approach to the Great Dividing Range and receives a pronounced winter-dominated distribution pattern. These mountains force moisture-bearing winds to rise, causing late summer thunderstorms to deposit rain in the Nillumbik Hills. These rainfall episodes produce major water runoff (e.g. February 1976 when 150 mm fell in 12 hours at Yarrambat). In the hills and ranges the wettest months are in spring and early summer (September to December) and often receive steady soaking rains. On the plains autumn and winter (March to July) have low rainfall due to the effects of the rainshadow, giving a uniform pattern of rainfall distribution. Throughout NEM, June and January are the driest months.

At Yan Yean the longest period of drought over the last 30 years was from January 1967 to March 1968 when 13 out of 15 consecutive months received less than their mean monthly rainfall. From February 1982 to February 1983, 12 out of 13 consecutive months received less than their mean monthly rainfall. The longest wet period was from January 1978 to January 1979 when 12 out of 13 consecutive months received higher than their mean rainfall. Heavy or prolonged rainfall episodes have usually led to flooding or swamp inundations. At Yan Yean, from 1960 to 1990 there were 19 months in which more than 100 mm of rain fell. A pronounced seasonal heavy rainfall/flooding pattern has emerged showing that the bulk of these months were during the spring and summer (e.g. eight spring months, seven summer months, four autumn months and nil winter months). There may be longer term cyclical trends of wet and dry periods. For instance, the decade of the 1960s received significantly below mean rainfall, that of the 1970s received significantly above mean rainfall and that of the 1980s received normal rainfall.

Table 2.1 Mean monthly rainfall (mm) data relevant to North East Melbourne (to 1990)

Station	Elevation (m)	Lat °S	Long °E	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Arthurs Ck	130	37°34'	145°12'	46.00	42.00	67.00	46.00	66.00	66.00	53.00	58.00	83.00	67.00	58.00	57.00	709.00
G'sbrough	60	37°42'	145°06'	52.00	46.00	59.00	63.00	53.00	56.00	54.00	53.00	60.00	70.00	57.00	62.00	685.00
Kinglake	550	37°31'	145°20'	73.00	76.00	83.00	104.00	108.00	114.00	110.00	112.00	108.00	119.00	105.00	96.00	1208.00
Melbourne	20	37°48'	144°57'	48.00	48.00	54.00	58.00	56.00	52.00	49.00	49.00	59.00	69.00	59.00	58.00	659.00
Toorr'ong	220	37°28'	145°09'	55.00	56.00	70.00	64.00	68.00	68.00	65.00	71.00	76.00	84.00	67.00	65.00	809.00
Wallan	320	37°24'	144°58'	43.00	48.00	50.00	55.00	59.00	62.00	54.00	61.00	65.00	68.00	57.00	52.00	674.00
Yan Yean	200	37°33'	145°07'	46.00	46.00	50.00	56.00	56.00	53.00	50.00	56.00	62.00	70.00	59.00	54.00	658.00

From 1960 to 1990, there were six years where annual rainfall was 20% or more below the mean (e.g. 1967, 1979, 1982 and 1984, with 1967 and 1982). These were drought years throughout NEM. The longest periods of successive drier than mean years were from 1967 to 1969 (inclusive) and 1979 to 1982 (inclusive). Most swamps in NEM were dry during these years. From 1960 to 1990, there were four years where annual rainfall was 20% or more above the mean (e.g. 1964, 1970, 1973 and 1978). The longest period of successive wetter than mean years was from 1973 to 1975 (inclusive). Most swamps in NEM were inundated during these years.

The rainfall pattern of the 1990s (so far) has departed from those established over the past three decades. The years have mostly been of above average rainfall. There is a developing trend for rainfall periods of extraordinary winter–spring maxima and summer–autumn minima within given years. For example ‘drought’ autumn 1991 followed by ‘flood’ winter–spring and ‘flood’ winter–spring 1996 followed by ‘drought’ summer 1996/97. It is possible that these trends are an early indicator of the future effects of ‘greenhouse’.

There are few rain stations on the volcanic plains of North East Melbourne. The isohyet contours of rainfall maps are extrapolated lines and do not necessarily show local patterns. Records kept by farmers between Craigieburn, Wollert and Kalkallo suggest that the mean annual rainfall in that area is 50 mm lower than maps indicate (i.e. 600–620 mm per annum). Local rainshadow areas of the foothills and ranges can also have substantially lower than expected readings (e.g. Dunmoochin at Cottles Bridge with 625 mm and Mt Everard in Kinglake NP with 700 mm despite being at 500 m elevation).

The monthly maximum, minimum and mean temperatures for the City of Melbourne are provided in Table 2.2. On the plains the trend is for an increase in maximum and minimum temperature extremes with distance from the coast. In the hills and ranges the trend is for a decrease in maximum and minimum temperatures with elevation. The mean number of frosts per annum increases with elevation in the ranges and distance from the coast on the plains.

Table 2.2 Bureau of Meteorology monthly maximum, minimum and mean temperature values (°C) for Melbourne (1880–1990)

	Month												Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean Month Max	25.80	25.60	23.70	20.10	16.40	13.80	13.20	14.80	17.20	19.50	21.90	24.20	19.70
Mean Month Min	13.80	14.10	12.70	10.40	8.20	6.70	5.60	6.30	7.60	9.10	10.70	12.50	9.80
Mean	19.80	19.80	18.20	15.20	12.30	10.20	9.40	10.60	12.30	14.30	16.30	18.30	14.70
$\frac{1}{2}$ Max+Min													

* Before the Present

CHAPTER 3

PHYSICAL ZONES OF NORTH EAST MELBOURNE

VOLUME 2—VOLCANIC PLAINS (VP)

Merri Upland Volcanic Plains (MUVV)

This biophysical zone contains farmland catchments of the upper Merri Creek from Donnybrook to Wallan East.

Past land-use included pastoral and townships. Present land-use includes pastoral, farmlets, townships and rock extraction.

The native vegetation cover is fragmented.

The most significant faunal species/populations are the Red-chested Button-quail, Little Button-quail, Plains-wanderer, Australasian Bittern, Latham's Snipe, Spotted Harrier, Swamp Harrier, Inland Broad-nosed Bat, Southern Lined Earless Dragon, Striped Legless Lizard, Plains Froglet and Common Spadefoot Toad.

Threatened plants include Curly Sedge, Small Golden Moths, Swollen Swamp Wallaby-grass, Barren Cane Grass, Swamp Everlasting, Swamp Groundsel, Small Pepper-cress and Tough Scurf-pea.

The most significant habitats are riparian scrub, cliff/escarpment shrubland, stony knoll grassland, plains grasslands and seasonal wetlands (particularly Hernes Swamp and Kalkallo Common).

Of particular note are the faunal rarity, abundance and diversity (particularly quail, birds of prey, lizards and waterbirds) and habitat rarity, abundance and diversity.

Key areas and physical features for biota are Merri Creek and its surrounds at Bald Hill, North Eastern Railway Reserve, Hernes Swamp and Kalkallo Common/Cemetery.

There are five sites of significance: one national, one state and three regional for fauna and two very high, two high and one medium for habitat.

Merri Lowland Volcanic Plains (MLVP)

This biophysical zone contains farmland and urban catchments of the middle and lower Merri Creek and Edgars Creek.

Past land use included pastoral and township. Present land use includes pastoral (in the north), farmlets, townships, urban (in the south), rock extraction and recreation (e.g. Edwards lake).

The native vegetation cover is extensive in the north and highly fragmented in the south.

The most significant faunal species/populations are the Brown Quail, Red-chested Button-quail, Little Button-quail, Plains Wanderer, Banded Lapwing, Latham's Snipe, Spotted Harrier, Swamp Harrier, Black Kite, Black Falcon, Budgerigar, Striated Fieldwren, Diamond Firetail, Zebra Finch, Fat-tailed Dunnart, Southern Lined Earless Dragon, Striped Legless Lizard and Red-bellied Black Snake

Threatened plants include the Curly Sedge, Matted Flax-lily, Swollen Swamp Wallaby-grass, Tough Scurf-pea Swamp Plantain and Small Milkwort.

The most significant habitats are grassy woodland, cliff escarpment shrubland, riparian scrub, stony knoll grassland (particularly Craigieburn Grassland), plains grassland, drainage line herbfield and seasonal wetlands (particularly O'Herns Road Wetlands).

Of particular note are the faunal rarity, abundance and diversity (particularly quail, birds of prey, reptiles and waterbirds) and habitat rarity, abundance and diversity, a volcanic plains ecological reference area, and volcanic plains strategic habitat link (particularly Merri Creek).

Key areas and physical features for biota are Merri Creek and surrounds, Craigieburn Grassland, O'Herns Road Wetlands, Cooper Street Grassland, Hendon Park and Bunker Hill Swamp/Boonderoo.

There are nine sites of significance: one national, five state and three regional for fauna and three very high, five high and one medium for habitat.

Plenty Lowland Volcanic Plains (PLVP)

This biophysical zone contains farmland catchments of the middle and lower Darebin Creek and middle Plenty River and its tributaries, including Barber Creek.

Past land-use included pastoral and townships. Present land-use includes pastoral, farmlets, urban (in south), rock extraction and recreation (e.g. horse riding).

The native vegetation cover is extensive in north and highly fragmented in the south.

The most significant faunal species/populations are the Red-chested Button-quail, Crested Pigeon, Latham's Snipe, Brolga, Masked Owl, Barking Owl, Purple-crowned Lorikeet, Long-billed Corella, Little Corella, Blue-winged Parrot, Rufous Songlark, White-browed Woodswallow, Inland Broad-nosed Bat, Southern and Eastern Freetail Bats.

Threatened plants include the Curly Sedge, Matted Flax-lily and Tough Scurf-pea.

The most significant habitats are River Red Gum plains woodland and stony knoll grassland.

Of particular note are the faunal rarity and diversity (particularly Fenwick/Darebin Creek for bats, owls and parrots), and habitat rarity and abundance; River Red Gum critical conservation area; and strategic habitat link between the upland hills, alluvial plains and volcanic plains and lowland volcanic plains and hills (particularly Plenty River and River Red Gum belt between Yan Yean and Woodstock).

Key areas and physical features for biota are the Fenwick and middle Darebin Creek woodlands/grasslands. Others localised occurrences include Epping Cemetery, rock walls/stony knolls, Quarry Hill, Bundoora Park and Darebin Parklands.

There are 10 sites of significance: 1 state and 9 regional for fauna and 1 very high 1 high and 8 medium for habitat.

VOLUME 3—ALLUVIAL PLAINS (AP)

Yarra Lowland Alluvial Plains (YLAP)

This biophysical zone contains urban catchments of the lower Yarra River from Hawthorn to Eltham South and the lower reaches of its tributaries including the Koonung Creek, Diamond Creek and Plenty River.

Past land-use was pastoral, orchards, market gardening and township/urban. Present land-use includes Yarra Valley Park, urban and recreation (e.g. Yarra kayaking and fishing).

The native vegetation cover is highly fragmented.

The most significant faunal species/populations are the Baillon's Crake, Lewin's Rail, Little Bittern, Australasian Bittern, Latham's Snipe, Nankeen Night Heron, Barking Owl, Swift Parrot, Regent Honeyeater, Eastern Broad-nosed Bat, Southern Freetail Bat, Peron's Tree Frog, Pouched Lamprey, Short-headed Lamprey, Australian Grayling, Tasmanian Mudfish, Spotted Galaxias, Common Galaxias, Broad-finned Galaxias and Eltham Copper butterfly.

Threatened plants include the Spotted Duckweed and Matted Flax-lily.

The most significant habitats are grassy woodland, floodplain riparian woodland, box-ironbark (Yellow Gum at Yarra Bend Park), swamp scrub and seasonal wetland.

Of particular note are the faunal (particularly waterbird) rarity, abundance (primarily parrots and fish) and diversity and habitat rarity, abundance and diversity (both for grassy woodland at La Trobe University and Simpson Barracks); and strategic habitat link between the lowland hills and lowland alluvial plains (Diamond Creek/Yarra River).

Key areas and physical features for biota are Yarra Valley Park including Bolin Billabong and Westerfolds Park, Banyule Wetlands, Lower Eltham Park, La Trobe University/Gresswell Forest, Yarra River, lower Plenty River and lower Diamond Creek.

There are 11 sites of significance: four state and seven regional for fauna and two high, eight medium and one unassessed for habitat.

Plenty Upland Alluvial Plains (PUAP)

This biophysical zone contains farmland catchments of the middle Plenty River and lower reaches of its tributaries including Bruces Creek and Scrubby Creek.

Past land-use was pastoral and townships. Present land-use includes farmlet settlement, urban/township and recreation (e.g. horse riding).

The native vegetation cover is highly fragmented.

The most significant faunal species/populations are the Baillon's Crake, Lewin's Rail, Little Bittern, Australasian Bittern, Sharp-tailed Sandpiper, Latham's Snipe, Painted Snipe, Blue-billed Duck, Australasian Shoveler, Glossy Grass Skink, Peron's Tree Frog, Plains Froglet, Common Galaxias and Southern Pigmy Perch.

There are no known occurrences of threatened plant species.

The most significant habitats are riverine forest, River Red Gum grassy woodland, swamp scrub, Rush Sedge seasonal wetland and Many-fruit Tassel permanent wetland.

Of particular note are the faunal (particularly of waterbirds and parrots) rarity, abundance and diversity and habitat rarity; the riverine forest and red gum marshland critical conservation areas; and strategic habitat link between the upland hills and lowland volcanic plains (Plenty River Mernda to Yan Yean).

Key areas and physical features for biota are Towts Swamp, Dunnetts Road Swamp, Staglanos Lake, Mornmoot Lake, Brennans Forest/lower Barber Creek and Plenty River.

There are four sites of significance: three state and one regional for fauna and two high and two medium for habitat.

VOLUME 4—LOWLAND HILLS (LH)

Plenty Lowland Hills (PLH)

This biophysical zone contains farmland, bushland and urban catchments of the lower Plenty River from Yallambie to Mernda and the lower Diamond Creek from Eltham to Wattle Glen.

Past land-use was pastoral, townships, orchards, firewood and mining. Present land-use includes Plenty Gorge Park, bushblock and farmlet settlement and outdoor education and recreation (e.g. horse riding and Yarrambat golf course) in the north; urban in the south and encroaching in the north.

Native vegetation cover is fragmented in the north and highly fragmented in the south.

The most significant faunal species/populations are the Blue-billed Duck, Barking Owl, Swift Parrot, Painted Honeyeater, Black-chinned Honeyeater, Regent Honeyeater, Yellow-tufted Honeyeater, Platypus, Large-footed Myotis (bat), Common Bent-wing Bat, Eastern Broad-nosed Bat, Flat-headed Gudgeon and Eltham Copper, Ictinus Blue and Genoveva Azure butterflies.

The most significant habitats are gully woodland, escarpment woodland, Blakely's Red Gum and River Red Gum (volcanic plain) grassy woodlands, box-stringybark woodland, box-ironbark woodland (Yellow Gum and Red Ironbark), Hill Manna Gum sand-plain woodland, floodplain riparian woodland, riparian scrub cliff/escarpment shrubland and seasonal wetland..

Threatened plants include the Spotted Duckweed, Matted Flax-lily, Charming Spider-orchid, Wine-lip Spider-orchid and Clover Glycine. The zone also supports some of the most extensive known populations of the rare Emerald Greenhood.

Of particular note is the faunal (including butterfly) rarity, abundance and diversity, habitat rarity and diversity (Plenty Gorge) and the St Helena orchid flora, the Yarrambat-Morang and Plenty-Janefield ecological reference areas and Blakely's Red Gum and Eltham Copper critical conservation areas.

There is a strategic habitat link between the upland hills and lowland alluvial plains (the Diamond Creek).

Key areas and physical features for biota are Plenty Gorge/Plenty Gorge Park (particularly Yarrambat Ironbarks/Smugglers Gully, Plenty River, Morang Wetlands, Purvis Gully and Plenty–Janefield Yellow Gums). Diamond Creek (particularly from Eltham North to Diamond Creek), Blakely’s Red Gum area east of Diamond Creek, Ironbark Road Reserve, Yandell Reserve and Eltham Copper Butterfly Reserves.

There are 14 sites of significance: two national, four state and eight regional for fauna and three very high, five high and six medium for habitat.

Yarra Lowland Hills (YLH)

This biophysical zone contains farmland, bushland and urban catchments of the middle Yarra River between Nillumbik South and Yarra Glen and the lower reaches of its tributaries including the Watsons, Mullum Mullum and Brushy creeks.

Past land-use included pastoral, townships, orchards, firewood and mining. Present land-use includes the Warrandyte State Park, Yarra Valley Park (upstream of Diamond Creek), bushblock and farmlet settlement, as well as urban/township and outdoor education and recreation (e.g. park information centres and trails) in the west and the Warrandyte State Park, bushblock and farmlet settlement, water supply, environmental living, pastoral and outdoor education and recreation (e.g. Clifford Park activity centre, horse riding and Yarra kayaking and fishing) in the east.

The native vegetation cover is fragmented in the west, extensive to the north of the Yarra upstream of Watsons Creek, and highly fragmented south of the Yarra east of Brushy Creek.

The most significant faunal species/populations are the Baillon’s Crake, Barking Owl, Powerful Owl, Swift Parrot, Azure Kingfisher, Regent Honeyeater, Little Friarbird, Platypus, Brush-tailed Phascogale, Common Bent-wing Bat, Large-footed Myotis, Glossy Grass Skink, Lesueur’s Tree Frog, Broad-finned Galaxias, Freshwater Blackfish, Large Ant-blue butterfly and Yellow-spot Jewel butterfly.

Threatened plants include the Spotted Duckweed, Wine-lip Spider-orchid, Rosella Spider-orchid, Leafy Greenhood and Clover Glycine. The zone also supports the most extensive known populations of the potentially threatened Bearded Greenhood and Billy Buttons (*Craspedia* sp. nova).

The most significant habitats are riparian and species-rich foothill forests, box–stringybark woodland, gully woodland, Red Ironbark escarpment, Yellow Box–Candlebark grassy woodland riparian scrub/swamp scrub, cliff/escarpment shrubland and seasonal and permanent wetland.

Of particular note are the faunal rarity, abundance and diversity, habitat rarity and abundance, Yarra–Yellow Box grassy woodland and Warrandyte Gorge ecological reference areas, the box–stringybark woodland, foothills streamway and riverine floodplain critical conservation areas, and the strategic habitat links between the upland hills and lowland alluvial plains (primarily the Yarra River and Watsons Creek).

Key areas and physical features for biota are the Yarra Valley Park including Pettys Wetland, Morrisons and Glynn’s, Yarra River, Yering and Warrandyte Gorges, Watsons Creek, Warrandyte SP, Professors Hill Flora Reserve, Kalbar Road Reserve, Pound Bend Tunnel, Round the Bend Cooperative, Yering Backswamp and the Maroondah Aqueduct.

There are 11 sites of significance: five state and six regional for fauna and three very high, five high and three medium for habitat.

Nillumbik Lowland Hills (NLH)

This biophysical zone contains farmland and bushland catchments of the middle Diamond Creek, lower Arthurs Creek and Long Gully Creek (tributary of the Watsons Creek).

Past land-use included pastoral, townships, orchards, firewood and mining. Present land-use includes bushland reserves, bushblock and farmlet settlement, townships, urban from Wattle Glen to Hurstbridge and recreation.

Native vegetation cover is fragmented.

The most significant faunal species/populations are the Masked Owl, Barking Owl, Regent Honeyeater, Common Dunnart, Brush-tailed Phascogale, Mountain Galaxias, Freshwater Blackfish and Yellow-spot Jewel butterfly.

Threatened plants species include the Matted Flax-lily, Charming Spider-orchid, Crimson Spider-orchid, Wine-lip Spider-orchid, Rosella Spider-orchid and Clover Glycine. The zone also supports some of the most extensive known populations of potentially threatened Bearded Greenhood.

The most significant habitats are riparian and herb-rich foothill forests, gully woodland, box-stringybark woodland, box-ironbark woodland (Red Ironbark) and Yellow Box-Candlebark grassy woodland.

Of particular note are faunal rarity, abundance and diversity. The Charming Spider-orchid, Wine-lip Spider-orchid, Rosella Spider-orchid-Red Ironbark critical conservation areas and the strategic habitat links between the upland and lowland hills (primarily Long Gully Creek and Diamond Creek).

Key areas and physical features for biota are Dunmoochin and Pittles Paddock, Diamond Creek, Arthurs Creek, Long Gully and Boomers Reserve, Koos Reserve, Red Shirt Gully Creek, Haleys Gully Road Red Ironbarks and Temple Ridge/Orchid Track.

There are 14 sites of significance: six state and eight regional for fauna and four very high, four high and six medium for habitat.

VOLUME 5—UPLAND HILLS (UH)

Nillumbik Upland Hills (NUH)

This biophysical zone contains farmland and bushland catchments of the upper Arthurs Creek, Diamond Creek (and tributaries including the Smiths Gully Creek and Yow Yow Creek) and Watsons Creek.

Past land-use included pastoral, townships, orchards, firewood and mining. Present land-use includes bushland reserves, bushblock and farmlet settlement, townships, orchards and recreation (e.g. St Andrews market grounds and Rob Roy hill climb).

The native vegetation cover is fragmented west of the Diamond Creek and extensive to the east.

The most significant faunal species/populations are the Barking Owl, Powerful Owl, Painted Honeyeater, Brush-tailed Phascogale, Common Dunnart, Common Bent-wing Bat, Eastern Horseshoe-bat and Tree Goanna.

Threatened plants include the Wine-lip Spider-orchid and Rosella Spider-orchid.

The most significant habitats are herb-rich foothill forest, gully woodland and box-stringybark woodland (Red Box).

Of particular note are the faunal and habitat rarity, abundance and diversity, the foothills ecological reference area, and the strategic habitat links between the ranges and lowland hills (primarily the Diamond Creek, Smiths Gully Creek, Watsons Creek and One Tree Hill).

Key areas and physical features for biota are One Tree Hill, Diamond Creek, Watsons Creek, Smiths Gully Creek, Yow Yow Creek and Chadds Creek.

There are nine sites of significance: five state and four regional for fauna and one very high, five high and three medium for habitat.

Plenty Upland Hills (PUH)

This biophysical zone contains bushland catchments of Yan Yean Reservoir and bushland and farmland catchments of the upper reaches of tributaries of the Plenty River including the Bruces Creek and the western tributaries of Arthurs Creek.

Past land-use included pastoral, water supply, townships, orchards and firewood. Present land-use includes pastoral, water supply, bushblock and farmlet settlement, townships, orchards and recreation (e.g. Yan Yean Reservoir picnic area).

The native vegetation cover is highly fragmented apart from the sections adjoining the ranges including the Yan Yean Reservoir catchment, which are extensive.

The most significant faunal species/populations (mostly at Yan Yean Reservoir) are the Peaceful Dove, Blue-billed Duck, Swift Parrot, Rainbow Bee-eater, Brown Treecreeper, Regent Honeyeater and Large-footed Myotis.

Threatened plants include the Matted Flax-lily, Purple Diuris, Basalt Plain Leek-orchid, Large-fruit Groundsel, Hypsela and Clover Glycine (each at Yan Yean Reservoir).

The most significant habitats are herb-rich foothill forests, heathy forest; grassy woodland ecological reference area (Yellow Box–Candlebark and Snow Gum), and box–stringybark woodland (Yellow Box and Long-leaf Box) each at Yan Yean Reservoir.

Of particular note at Yan Yean Reservoir are the faunal rarity, abundance and diversity (particularly of waterfowl) and the strategic habitat link between the ranges and lowland hills/plains, as well as habitat rarity and abundance and orchid rarity and diversity.

Key area and physical features for biota are Yan Yean Reservoir catchment.

There are seven sites of significance: two state and five regional for fauna and two very high and five medium for habitat.

VOLUME 6—RANGES (R)

Hume Ranges (HR)

This biophysical zone contains mountain forest catchments of the Plenty River, Bruces Creek and Scrubby Creek headwaters.

Past land-use: pastoral (foothills), townships, timber harvesting and water reserves. Present land-use: townships, water reserves, timber harvesting, bushblock and farmlet settlement, bushland and recreation (e.g. Whittlesea golf course and Toorourrong Reservoir picnic area).

The native vegetation cover is extensive except at the margin of the cleared plateau and softwood plantations at Kinglake West and in the foothills at Humevale.

The most significant faunal species/populations are the Lewin's Rail, Baillon's Crake, Little Bittern, Blue-billed Duck, Grey Goshawk, Sooty Owl, Barking Owl, Powerful Owl, Superb Lyrebird, Eastern Whipbird, Pilotbird, Satin Bowerbird, Platypus, Brush-tailed Phascogale, Dusky Antechinus, Greater Glider, Eastern False Pipistrelle, Mountain Dragon, Spencer's Skink, Mountain Galaxias, Freshwater Blackfish and Mountain Skipper and Victorian Hair-streak butterflies.

Threatened plants include the Austral Moonwort and Fairy Lanterns. Significant plant species include the Creeping Grevillea and Butterfly Orchid.

The most significant habitats are cool temperate rainforest/fern galleries and wet sclerophyll, damp riparian, damp sclerophyll, riparian, herb-rich foothill (Messmate and Red Stringybark) and heathy forest at the Plenty River headwaters and seasonal wetland at Toorourrong Reservoir.

Of particular note are the faunal, habitat and orchid rarity, abundance and diversity; wet mountain forest ecological reference areas; and strategic habitat links between the ranges and upland hills.

Key areas and physical features for biota are Mt Disappointment, Plenty River, Bruces Creek, Scrubby Creek, Joey Creek, Jack Creek and Toorourrong Reservoir.

There are six sites of significance: five state and one regional for fauna and one very high, three high and two medium for habitat.

Kinglake Ranges (KR)

This biophysical zone contains mountain forest catchments of Arthurs Creek (including the Running and Chadds creeks), Diamond Creek (including Broad Gully), Watsons Creek and Steels Creek (including the Jehosaphat and Full and Plenty creeks).

Past land-use included townships, orchards, vegetable growing, timber harvesting and water supply. Present land-use includes townships, Kinglake National Park, bushblock and farmlet settlement, orchards, vegetable growing, bushland and outdoor recreation and education (e.g. park information centres, walking trails and picnic areas, particularly Masons Falls).

The native vegetation cover is extensive except at the margin on the cleared section of the Kinglake Plateau and the Arthurs Creek valley at Strathewen and Steels Creek valley at Steels Creek.

The most significant faunal species/populations are the Sooty Owl, Barking Owl, Powerful Owl, Red-tailed Black-Cockatoo, White-throated Nightjar, Superb Lyrebird, Southern Emu-wren, Eastern Whipbird, Lewin's Honeyeater, Spot-tailed Quoll, Brush-tailed Phascogale, White-footed Dunnart, Southern Brown Bandicoot, Eastern Pygmy-possum, Yellow-bellied Glider, Red-necked Wallaby, Eastern Horseshoe-bat, Common Bent-wing Bat, Tree Goanna, Mountain Dragon, Black Rock Skink, Metallic Skink, Spencer's Skink, Mountain Galaxias, Broad-finned Galaxias, Anderson's Skipper, Mountain Spotted Skipper, Eliena Skipper, Genoveva Azure, Large Ant-blue, Small Ant-blue, Bright Copper, Yellow-spot Jewel, Victorian Hair-streak and Blotched Blue butterflies.

Threatened plants include the Crimson Spider-orchid and Green Leek-orchid. Other significant plant species include the Nettle Brake, Summer Spider-orchid, Butterfly Orchid, Cliff Cudweed, Tangled Pseudanthus, Swamp Bush-pea and Creeping Grevillea.

The most significant habitats are wet sclerophyll forest/cool temperate fern galleries (particularly Jehosaphat Gully), damp riparian forest, damp sclerophyll forest, riparian forest, heathy forest, herb-rich foothill forests (Messmate and Red Stringybark), gully woodland, heathy woodland, upland scrub (Bald Spur and Mt Everard) and wet heath (Broad Gully).

Of particular note are the fauna (particularly birds, mammals and butterflies); habitat, plant and orchid rarity, abundance and diversity; mountain heath ecological reference area (particularly the heathland flora of Broad Gully); and strategic habitat links between the ranges and upland hills.

Key areas and physical features for biota are Kinglake NP, Diamond Creek headwaters, Broad Gully/Mt Beggary/Mt Everard, Arthurs/Chadds Creeks headwaters, Bald Spur, Masons Falls disjunct cliff community, Running Creek/Reservoir, Jehosaphat Gully/Creek, Watsons Creek and Yarra Glen-Mt Slide Road Mine/Fully and Plenty Creek.

There are four sites of significance: three state and one national for fauna and two very high and two high for habitat.

CHAPTER 4

FIELD SURVEY , DATABASE AND ANALYSIS

FIELD SURVEY

Selecting sites for data collection

Topographical maps (1:25 000) of NEM were used to identify all large areas (>100 ha) of native vegetation and topographic features. After field examination of these, smaller stands and remnants of native vegetation were examined, including roadside verges and strips of vegetation along watercourses. Wetlands, including farm dams, identified from maps and aerial photographs were visited. Geological, geomorphological and human-made features likely to provide specialist habitat were also examined (e.g. tunnels, mineshafts, sewage treatment plants).

Survey techniques

Extensive searches were undertaken to identify the range and distribution of faunal habitats and distinctive geological features (e.g. cliffs and gorges) and human-made features (e.g. mineshafts and dams). Preliminary lists were compiled of fauna and flora from each major habitat type.

Availability of access combined with local knowledge played a part in the selection of sites. Specific surveys were conducted (e.g. timed herpetofauna searches for the Striped Legless Lizard and Earless Dragon) in small homogeneous patches of natural habitat such as grassland remnants, which often yield high population density and low diversity of faunal species. At trapsites and other point localities selected for intensive survey, lists and counts were made of all observed vertebrate species. Physical features including landform, elevation and geological and soil types were also recorded.

The structure and floristics of each habitat were documented at each site. These are summarised under the habitat descriptions at the beginning of each biophysical region (Volumes 2 to 6).

The survey techniques outlined below for birds, mammals, reptiles and amphibians were those used throughout GM. They follow standard vertebrate survey techniques as described in Norris *et al.* (1983), Emison *et al.* (1984), Yugovic *et al.* (1990) and Schulz *et al.* (1991). Field survey and trapping was conducted under Scientific Research Permit and with permission from land managers or landowners. Field work in NEM was conducted between January 1986 and December 1996.

Reference grids

Areas selected for systematic survey were within 1' latitude x 1' longitude grids (approximately 2.2 km²) based on the 1: 100 000 NATMAP topographic series. This grid size normally enabled data to be exclusive to a particular site. The selected grids contained optimal and representative habitat within the site and were normally intensively surveyed by mammal trapping, spotlighting and extensive or specific searches for avifauna, herpetofauna and plants. Reference grids provide the base level for data storage, and analysis and interpretation of the study. They are shown on maps 2 and 3 (back pocket). For an example of their use see the User's Guide at the beginning of this volume.

Birds

Bird survey depends on being in the right place at the right time. Active searches for birds were conducted at all sites. Estimates of bird numbers were taken at each data collection point. Complete counts of waterbirds were made at specific wetlands. Sites containing cyclic flowering eucalypts which attracted threatened nectar-feeding birds such as the Regent Honeyeater and Swift Parrot were visited during two flowering cycles. Unless otherwise stated, all sites were visited during spring and autumn and at least once at night using a

hand-held spotlight. Play-back tapes were used to achieve a broader overview of the distribution of the Masked Owl and Sooty Owl. Some night spotlighting from vehicles was conducted for the location of Plains-wanderers. Indirect signs, such as nests, feathers, regurgitated pellets (owls) and the characteristic probe marks and footprints of species such as Latham's Snipe and species of crakes and rails were recorded.

Despite the database being open for ten years, new site records of birds frequently come to hand (particularly of waterbirds from developing wetlands). Some birdlists for sites are already out-of-date. The fact that no period of prolonged drought (such as 1982/83) occurred meant that several inland species were infrequently recorded. These may be locally common in the next drought.

Seasonal bird census

(see Chapter 5 for further explanation and individual site reports for results and discussion)

Standardised point or strip counts were conducted in the following habitats:

Valley forest/gully woodland (Yellow Box)	October census (focus on migratory tree canopy insectivores) over consecutive days and years. Repeatable 20-minute/2 ha plot counts of avifauna in a series of Yellow Box-Candlebark valley forest and various gully woodland area and connectivity classes. The plots were established as long-term reference and monitoring points to provide a model for the effectiveness of habitat links as faunal corridors and the adequacy of habitat patches to maintain faunal populations (habitat connectivity).
Grassy woodland (River Red Gum)	October census (focus on foliage insectivores and parrots) over consecutive days and years. Repeatable 5-minute/0.5 ha plot counts of avifauna in a series of tree density and connectivity classes of River Red Gum. The rates of invertebrate and mammal leaf damage were measured. The plots were established as long-term reference and monitoring points to provide a model for dieback control and habitat connectivity.
Box-ironbark woodland (Red Ironbark/Yellow Gum)	June/July census of nectivores (honeyeaters and lorikeets) from repeatable 20-minute/2 ha plot counts. Measurements of nectar/flower production were made at the peak of the Red Ironbark flowering season. Unpublished field data of annual counts conducted between 1977 and 1991 and full daylight reference tree counts of nectar feeders were reviewed. The plots were established as long-term reference and monitoring points to provide a model for dieback control and habitat connectivity and data on raising the viability of these stands for nectar feeders. Habitat requirements and relationships between winter flowering eucalypts and nectar-feeding birds were assessed.

Mammals

Trapping for ground and arboreal mammals was undertaken at most sites in the foothills and ranges using Elliott type A aluminium traps and small (30 x 25 x 25 cm) or large wire cage traps (90 x 30 x 30 cm) baited with a mixture of peanut butter, rolled oats and honey. Baits of sardines or scorched rabbit were set in large wire cage traps in attempts to catch Tiger Quolls. Traps were laid on the ground in groups of 10-20 along lines, each trap spaced at 5 to 10 m intervals and in tree branches up to 7 m above ground. Traps were left in position for one to three days and checked daily. Short lengths of PVC pipe lined with strips of double-sided adhesive tape (hair tubes) were occasionally laid in areas accessible to the public, where traps were considered at risk from interference. Mammalian hair samples were analysed.

Active searching for mammals included observations of flushed or active individuals and road-killed specimens. Rocks, logs and other ground material were examined as were the stomach contents of road-killed predators (e.g. snakes). Some skeletal material in predator scats and owl pellets was analysed. Indirect techniques included identifying burrows, scats, tracks, feed sites (e.g. Water Rat) and runways (e.g. Swamp Rat).

Presence of the Platypus and Water Rat was determined by:

- dusk watches for activity on deep still sections of watercourses or wetlands;

- day walks along streams. Most sections of all major streams were covered at least once. The Yarra River was surveyed by canoe in December 1988;
- searching watercourses and wetland banks for burrows; those of the Platypus are usually just above the water level, amongst vegetation or a tangle of tree roots. Large wire cage traps baited with sardines were set along banks for Water Rats;
- searching mudflats for tracks and the characteristic scats of Water Rats;
- locating Water Rat feeding table sites on logs, tree stumps and rock platforms. These contain fragments of food remains such as invertebrate exoskeletons, fish scales, feathers, hair and bones; and
- incidental observations while electrofishing and netting.

Dunnarts are difficult to catch in conventional traps and were detected by searching under rocks, logs, sheets of iron and other materials during the day. The Fat-tailed Dunnart constructs characteristic grass nests and simple tunnel structures beneath rocks; exoskeletons of invertebrate prey being usually present. It is most readily located under loose basalt rocks in winter. Few individuals were found under rocks when temperatures rose above 30°C in summer and autumn as they then tend to move into soil cracks. The population density of the Fat-tailed Dunnart on the Craighieburn Grassland was estimated by spotlighting from a vehicle.

A survey of almost 2000 bat trap-nights was undertaken in the fauna study of GM. Approximately 50% of the effort was undertaken in NEM. Trapping was conducted along tracks and watercourses, at dams and waterbodies where tree cover and overhanging branches create flight paths, and at entrances to caves or tunnels. Bats were trapped using modified harp traps, monofilament mistnets and triplines placed across waterbodies. Because bats are most active during the warmer months of October to April, trapping effort was largely confined to warm still nights. In general, most surveying of bats at wetlands and woodlands was conducted on private land and that in forests was on public land. Tunnels, overhangs and cliff faces, the undersides of bridges and major bank erosion areas along watercourses were searched for roosting Large-footed Myotis and Common Bent-wing Bats. Ceilings, shingles and corrugated iron in old buildings were also examined for bats or signs of their occupation such as scats.

Arboreal mammals were observed by using spotlights (50 w) with portable 12 volt batteries; 10 x 40 power binoculars being used to assist identification. Stagwatching involved observing hollows and spouts in large trees (particularly Mountain Grey Gums in the ranges) supporting ample tree-hollows from full daylight to 30 minutes after dark. Playback tapes were used to elicit responses from Yellow-bellied Gliders in the ranges.

Reptiles and amphibians

Pitfall traplines usually consisted of 5–10 deep buckets placed at 5 m intervals along a fly-wire drift fence. Traps were open for 5–20 days and were checked daily. Trapped animals were identified and the breeding condition was noted. All animals were released at the point of capture.

Locating most reptiles and amphibians involved active searching including timed herpetofauna surveys. Damp microhabitats in or under rocks and fallen logs and amongst ground litter were inspected for sheltering amphibians. Dry microhabitats such as logs, rocks, dead clumps of grass and dumped rubbish (particularly corrugated iron and abandoned car debris) were searched for reptiles. Basalt cliff crevices along creeks on the volcanic plains were searched for Marbled Geckos, skinks, dragons and frogs. Searches under decorticated bark and by spotlight were also made for the nocturnal gecko. Rocky outcrops and logs and piles of rubbish along watercourses were surveyed from a distance (20–50 m) through binoculars for active or basking reptiles and tortoises, in particular the Southern Lined Earless Dragon and Cunningham's Skink. Nearly 2500 km and 1500 hours of a systematic walking and rock-rolling survey of watercourses and nearby rocky grassland areas on the volcanic plains of GM during the 1986 to 1996 survey period failed to locate any Earless Dragons. Ten to 15-minute watches at vantage points in localities showing the best potential habitat (about 30) detected single dragons on five occasions

Herpetofauna sampling is affected by the season of survey. In summer and autumn the basaltic soils are characteristically dry, some are deeply cracked. Rather than sheltering under rocks or other ground debris,

animals tend to shelter in grass tussocks or move underground into the cracks. The dry winter of 1988, when a majority of the species sheltered under rocks, was a successful period for locating herpetofauna, particularly the Striped Legless Lizard.

Active and calling frogs were located at night at waterbodies and watercourses. Search efforts largely followed periods of heavy or prolonged rainfall, which, along with favourable temperatures, act as a trigger for amphibian activity. Searches were conducted along watercourses, in cracks and crevices in cliffs and rock outcrops and under debris both in and out of the water.

Freshwater fish

Between 1988 and 1992, CNR (now NRE) Freshwater Fish Management Branch conducted an electrofishing survey of the major tributaries of the Yarra River occurring in NEM. Fifty-two electrofishing sites were sampled in each of the major streams and some waterbodies. The lower, middle and upper reaches of streams were sampled. This study was used for the rationale and application of the North East Melbourne Regional Hydrological Strategy.

Sites were selected to give a variety of stream conditions and habitats and to provide accessibility for electrofishing. The sites will become permanent reference points for environmental and scientific monitoring and research. Techniques follow those outlined in McKenzie and O'Connor (1989). Along streams and in the shallows of waterbodies, a Smith-Root 7.5 GPP model electrofisher or Smith-Root backpack model 12 electrofisher was used. The output of the units was 100 to 1000 volts DC and 4 to 40 amps at a conductivity rate of 10 to 10 000 microseimens. The sample time usually was between 30 and 60 minutes, covering up to 200 m of stream.

Fyke and/or mesh nets were set overnight in deeper water. These were attended in 'Platypus waters'. The mesh nets were 25 m long with a 2.5 m drop and stretched mesh sizes of 25, 50, 75 or 100 mm. The fyke nets had a stretched mesh size of 25 mm and a single central wing.

Fish were measured to the nearest 1 mm (total length or caudal fork length for Roach), weighed, identified and counted. When large numbers of fish were encountered an estimate of population size was made.

The biota of stream ecosystems can be influenced by four primary variables: water quality, flow regime, nutrient sources and habitat structure and their interactions (Koehn & O'Connor 1990). Changes to any of these variables will alter the stream ecosystem structure and function. Native aquatic ecosystems contain a complexity of biological, physical and chemical interactions and are generally sensitive to habitat degradation and pollution. At each sample site, water temperature, conductivity and turbidity readings were taken and stream width and depth and length of sample were recorded. Salinity readings were taken in Arthurs, Diamond and Watsons creeks. An assessment of instream habitat and riparian vegetation was made at each site.

Water temperature, salinity (in parts per thousand) and conductivity (measured in microseimens) were recorded with a YSI 33 S.C.T. meter. Salinity is a measure of the total concentration of dissolved inorganic material in water. Water is regarded as saline when concentrations exceed 3 ppt. Conductivity and turbidity levels provide an environmental measure of the degree of disturbance in the catchment caused by human settlement. An estimate of the water turbidity was made. Turbidity is the degree of suspended matter in the water (estimated by the amount of light penetration) and provides an environmental measure of water quality and changes in the pattern of runoff from processes such as land clearing and over-grazing by livestock.

Instruments to measure flow rate accurately were unavailable. The flow rate was measured by a standardised time (10 seconds) estimate of the riffle depth and width (area of water) and velocity. The flow rate is the conversion of area and velocity to volume per unit time. The standardised approach allows a comparison between the sites. Visual assessments of the substrate and bank type and condition, erosion and weed invasion were also recorded at each sample. The cover and abundance of instream, bank and frontage vegetation types and dominant plant species were recorded.

In July 1992, two work experience students from Deakin University conducted water quality assessments at each of the 18 electrofishing sites in Arthurs Creek, Diamond Creek and Watsons Creek in the Shire of Eltham (Humphries & Raymond unpub. report). The students recorded each of the physical parameters

described during the electrofishing survey and two additional parameters (pH and dissolved oxygen, expressed in parts per million). At five sites, chemical analyses were undertaken. These included tests for phosphates and nitrates (a measure of the by-products of human settlement), Calcium and the metals, Copper and Zinc. *E. coli* bacteria counts were not conducted as the analysis is not a cost-efficient exercise. An analysis of the *E. coli* and organochlorines (pesticides and insecticides) for each of the 18 sites would be desirable and would complement the biological and physical dataset already gained.

Butterflies

Standardised seasonal butterfly surveys were undertaken in approximately 30 sites (predominantly in the hills and ranges). Lists were recorded at one minute grid level.

DATABASE

Fauna

Over 100 000 faunal species records were obtained in GM during the survey period (1986 to 1996). These records were collected on approximately 4000 field data sheets (localities).

Data from other sources

Records from the Museum of Victoria and the Atlas of Victorian Wildlife (ARIER) have been incorporated. Similarly, data were extracted from the literature including journal articles and management plans on areas within NEM. Interviews with local residents provided valuable supplementary data, particularly on birds, mammals and fish. An extensive body of field data and ecological information was obtained from wildlife research scientists and field naturalists (see Acknowledgments). Those who had spent extensive time over several years compiling fauna lists of specific areas within the study area provided critical information. Anecdotal information was gathered from farmers, local residents and quail and duck shooters. This provided data that could not otherwise have been obtained during this study (see Acknowledgments).

Data storage

The fauna data collected during the NEROC study was donated to the Atlas of Victorian Wildlife database (ARIER). The Atlas records the fauna and their abundances at point localities or at broader resolutions (e.g. 2' latitude x 2' longitude grid system). It provides distribution maps and lists of vertebrate fauna. Around 50 000 records from approximately 2500 field data sheets collected in NEM were entered on the Atlas. This database is equal in size to that existing on the NRE Atlas of Victorian Wildlife collected from all previous biological surveys in Victoria for all time. It is the most systematic and comprehensive database ever collected in Victoria.

Nomenclature

The nomenclature for birds follows the RAOU (1995), for mammals Menkhorst (1995), for reptiles and amphibians Cogger (1996), for freshwater fish Koehn and O'Connor (1990) and for butterflies Common and Waterhouse (1981). The common names follow the Atlas of Victorian Wildlife. Scientific names of all species of mammals, birds, reptiles and amphibians are given in Appendix 1.2.

DATA ANALYSIS

Underlying propositions

- a Viable free-ranging populations of every scientifically recognised taxonomic entity (usually species but sometimes subspecies or forms) within NEM should be conserved.
- b This conservation should be accomplished as efficiently as possible.
- c Land-use changes and the consequent changes in wildlife populations are continuing in the study area. The data used in the analysis was based on recent (post-1986) empirical evidence. Populations of these species

currently utilise the sites and with proper management should continue to do so. The analysis is based on the recorded presence of each species at each locality.

Many birds utilising sites within GM range widely across Australia and beyond. Sites should not be treated in isolation; they may play a part in the life cycle of nomadic, migratory or wide-ranging species of birds. Species may depend on these sites during critical periods of their annual or life cycles, or as drought refuges when their normal habitats elsewhere diminish. Adequate conservation depends on appropriate management policies that incorporate species requirements over all their range and habitat. Many waterbird species that range beyond Australia are covered by international treaties (e.g. JAMBA and CAMBA) that are designed to protect the birds and their habitats in different countries to ensure their long-term survival. Some species that have restricted breeding sites (e.g. Pied Cormorant at Lake Borrie on the Werribee Sewage Farm, see Schulz *et al.* 1991) feed widely over GM and beyond. Their survival depends not only on the preservation of breeding sites but also on the maintenance of feeding grounds. Similarly, some threatened migratory or nomadic bird species which breed outside GM (e.g. Freckled Duck, Orange-bellied Parrot, Swift Parrot and Regent Honeyeater) depend on it for food resources. Regional, state-wide and national management strategies are needed for such species to ensure their survival and ultimate recovery.

To systematically analyse the data, GM was divided into a grid system of 2' latitude x 2' longitude grids (a 2' grid is approximately 9 km² in area). The distribution of each species (excluding fish and exceptions below) was quantified by the number of 2' x 2' grids in which it had been recently (post-1986) and reliably recorded. Eight hundred 2' grids in GM were entered with data during the survey.

Species that have specialised biological requirements or that are regarded as threatened in Victoria were given priority in the analysis. These include:

- species regarded as endangered or vulnerable using IUCN classifications in Australia (following CONCOM in prep.) or Victoria (following CNR 1995); and
- species that have specialised biological requirements or restricted colonial breeding or roosting sites. For these species the distribution ranking was determined by the localities of communal sites and all such sites were 'required'. Sites of communally breeding species that use transitory human-made facilities (e.g. Silver Gulls breeding in rubbish tips) and have ample natural breeding sites in the GM are not included in the analysis.

Species **not included** in the analysis were:

- native vagrants (birds) or escapees in GM; and
- introduced species, including *Canis familiaris* (treated as feral dogs).

CHAPTER 5

BIRD CENSUS METHODS

VALLEY FOREST/GULLY WOODLAND BIRD CENSUS

Ten 20-minute/2 ha counts were conducted in October 1989 and 1990 in a number of adjacent valley forest/gully woodland sites. The results are discussed in individual sites 65–67, 69, and 75–78 all in the Nillumbik Lowland Hills (NLH).

PLENTY VALLEY RIVER RED GUM BIRD CENSUS

Discussion

Foliage loss caused by native insect species has been frequently implicated in the cause of rural tree-dieback in Australia (Kile 1981). The objective of the census was to determine the abundance and distribution of insectivorous birds in differing tree density classes of River Red Gums and the level of their effect on controlling populations of leaf defoliating insects. The ability of existing stands to support populations of insectivorous birds and the dynamics of foliage insect populations were assessed.

Forest species are those dependent on intact, extensive and connected stands of forest or woodland vegetation. They inhabit fragmented stands in reduced numbers and are normally absent from highly fragmented stands. Woodland species are those occurring at highest density in intact, extensive and connected stands of woodland vegetation. They inhabit fragmented stands in reduced numbers and highly fragmented stands, urban parks and treed farmland in low numbers. Shrubland species are those inhabiting shrub layer vegetation under forests and woodlands. They inhabit fragmented stands in reduced numbers and highly fragmented stands, urban parks and farmland in low numbers. Fragmentation and farmland species are those which inhabit highly fragmented forest and woodland stands such as urban parks and treed farmland in larger numbers. They also inhabit fragmented stands and enter the margins of unfragmented stands.

Methods

An insectivorous bird census study was conducted in October 1988 and 1989 in the Plenty Valley between Yan Yean and Woodstock. The study consisted of 20 plots in four tree density classes of River Red Gums (forest, woodland, open woodland and treed farmland). The open woodland class was divided into two further categories, unfragmented and fragmented. The unfragmented plots were in the middle of the largest and most intact stands available while the fragmented plots were at the edge of these stands. The five River Red Gum classes were:

- 1 forest: fragmented stands of <10 ha with more than 40 trees/ha;
- 2 woodland: fragmented stands of <50 ha with 20–39 trees/ha;
- 3 open woodland: unfragmented stands exceeding 100 ha with 10–19 trees/ha—plots contained in interior habitat;
- 4 open woodland: fragmented stands of <50 ha with 10–19 trees/ha—plots contained in peripheral habitat; and
- 5 treed farmland; fragmented stands of <10 ha and 10 trees/ha.

Each class consisted of four plots censused over five days in the last week of October in two consecutive years (1988 and 1989). The census period coincided with the breeding season for most species (when detectability is relatively high). A total of 40 census counts was made in each class. All birds seen or heard in the census plots were recorded during 5-minute counts over a 1 ha plot. This plot was determined by measuring a circle of 55 m radius from a central, permanent reference tree. Bird counts of all plots alternated

between morning (7–11 am) and evening (4–7 pm) of consecutive days. All trees within the plot with DBH exceeding 20 cm were counted.

To quantify invertebrate leaf damage, 10 leaves were randomly collected from the mid-canopy of the central reference tree at each plot. The area of damage on each leaf was then visually estimated. Sap-sucking by psyllids (*Cardiaspina* spp. and *Hyalaspina* sp.) and skeletonising of green leaf tissue by Gum-leaf Skeletonisers (*Uraba lugens*) on River Red Gum leaves is characteristic and the amount of leaf damage caused by each was scored. The study revealed that the proportion of damage attributable to these increased with decreased tree density and stand size (accounting for about 90% of leaf damage caused by insects in healthy stands and almost all damage in dieback stands).

Damage by leaf chewing and cutting insects such as Christmas beetles (*Anoplagnathus* spp.), sawfly larvae (*Perga* spp.), chrysomelid beetles (*Paropsis* spp.) and weevils (various genera) was measured by estimating the area of eaten leaf, but individual damage attributable to these could not be separated. The proportion of damage attributable to this group of insects increased with tree density and stand size, but was still relatively small compared to the damage caused by the sap-suckers and skeletonisers. Chrysomelids and weevils are collectively referred to as leaf beetles.

All plots have been set up as permanent reference points to enable scientific monitoring of effects resulting from habitat or climatic change. The census was conducted over a two-year period to enable statistical analysis, offsetting the inherent variability and unpredictability of single season surveys. Similar to Ford (1981) and Ford and Bell (1982) it was found that foliage insectivore species diversity (the number of different species present) and species density (the populations of each species present) declined with both decreased tree density and increased degree of fragmentation of the study plots. Data summaries of the River Red Gum bird census are presented in Table 5.1.

Decreased tree density

As tree cover is reduced by land clearing the environment becomes less suitable for remnant native species of flora and fauna because of stress from increased exposure to climatic extremes (e.g. high winds and temperatures caused by loss of canopy cover and shade) and the effects of environmental perturbations (Kile 1981, Heatwole & Lowman 1988). The Plenty Valley census study found that with declining tree density, selective guilds of species were eliminated, particularly free density-dependent insectivores (forest species) such as the Spotted Pardalote. In healthy stands of River Red Gum not only is the diversity of foliage insectivores important but it is critical that each species is present in substantial numbers. Results of the census showed that the species diversity and density of foliage birds in plots of forest and unfragmented plots of open woodland was significantly higher than those severely affected by leaf defoliation and dieback on treed farmland (Table 5.1).

The richness and density of foliage insectivores declined with decreased tree density. Insect leaf damage, foliage cover loss and tree crown dieback were found to be inversely proportional to tree density. The rate of damage increased dramatically when tree density decreased below a critical level of 10 trees per hectare.

The populations of woodland foliage insectivores (e.g. Striated Pardalotes and White-plumed Honeyeaters) also decreased markedly with decreasing tree density (Table 5.1). These were found to be the only canopy insectivores in treed farmland and, alone, were unable to contain defoliating insect populations. Striated Pardalotes, which nest in tree-hollows, have a higher potential reproductive output than foliage nesting species through lower rates of parasitism from cuckoos and nestling predation and higher average clutch size and output per brood (Woinarski 1989). This advantage and hence the ability to exploit seasonal insect population outbreaks may not be realised if either the food resources in times of food shortage between these outbreaks or the availability of nest sites in tree hollows becomes limited (through tree thinning and stand fragmentation).

Table 5.1 Plenty Valley River Red Gum bird census summary

Habitat category	Plot number	Tree density /ha	Ins/vore diversity /ha	% Leaf damage /ha	Ins/vore density /ha	Spotted Pard. density	N. Miner density	Stand area (ha)
Forest (fragmented)	3	65	15	6	22.0	3.6	0.6	< 10
	4	40	13	7	19.0	2.4	0.8	< 10
	27	53	14	2	26.0	4.2	0.0	< 10
	28	48	12	2	20.0	1.6	0.0	< 10
Woodland (fragmented)	1	22	9	18	12.6	0.0	6.4	< 50
	2	24	6	16	10.8	0.0	3.4	< 50
	5	21	4	21	11.2	0.0	3.6	< 50
	6	20	8	12	12.0	0.2	2.8	< 50
Open woodland (unfragmented)	23	14	11	10	17.0	0.8	0.8	100+
	24	13	12	9	16.4	0.6	0.8	100+
	25	12	11	8	15.6	0.4	1.2	100+
	26	11	9	10	13.2	0.2	1.4	100+
Open woodland (fragmented)	12	13	4	35	6.7	0.0	3.0	< 50
	13	12	4	25	8.2	0.0	2.6	< 50
	16	13	5	29	8.8	0.0	1.8	< 50
	17	14	4	30	9.1	0.0	3.4	< 50
Treed farmland	10	2	3	69	2.2	0.0	0.0	< 10
	11	3	3	75	1.2	0.0	0.0	< 10
	20	3	4	79	3.4	0.0	0.0	< 10
	21	3	4	75	3.2	0.0	0.0	< 10

Decreased stand area (increased stand fragmentation)

Data from unfragmented and fragmented open woodland census plots was compared (Table 5.1). The richness and density of foliage insectivores declined proportionally with increasing stand fragmentation. Similar to the effect of decreasing density of the tree stratum (from forest, woodland, open woodland to treed farmland), insect leaf damage and tree crown dieback was directly proportional to the degree of stand fragmentation.

Habitat link connectivity and utility

Forest (tree density-dependent) foliage insectivores inhabit stands of River Red Gum forest, woodland and open woodland which contain adequate areas of internal habitat to support their feeding and breeding territories. Defoliation caused by insect damage in the unfragmented stands was about one-third the rate of damage in fragmented stands of open woodland. Several single sightings of transient forest insectivores were made in the fragmented woodland plots (plots 5 and 6) along the Old Whittlesea Railway reserve (strip about 30 m wide). The strip acted as an important avifauna corridor. During revegetation programs, habitat links need to be sufficiently diverse (floristically and structurally) and wide (ideally 100 m or more) to convey forest species.

Narrow habitat links or fragmented and thinned stands provide ideal habitat for Noisy Miners. The high rate of leaf damage in these stands was apparently due to lower numbers of foliage insectivores and higher numbers of Noisy Miners. Noisy Miners have benefited from woodland fragmentation as they more successfully maintain territories when these contain clumps of trees surrounded by open space. They defend territories aggressively against other foliage insectivores and, in the absence of other foliage birds, fail to control psyllids and other foliage insects (see Loyn 1985). These insects play a crucial role in the dieback cycle (see Chapter 8, Widespread Threatening Processes).

The prey items of foliage birds

Key species in maintaining control of psyllids include the Spotted and Striated Pardalotes (Woinarski 1985) and White-plumed Honeyeater (Wykes 1985). During the River Red Gum bird census both pardalotes occurred at highest density in forest and unfragmented stands of open woodland (Table 5.1). The Old Whittlesea Railway plots of fragmented woodland supported mainly transitory Spotted Pardalotes, although a small breeding population was located near plot 6 in the banks of Barbers Creek.

The Spotted Pardalote was observed feeding almost exclusively on psyllid larvae, which it extracts from under the insect's starchy excrement, built into an encrusted exoskeleton (lerp) on the River Red Gum leaves. The pardalote's occurrence was almost exclusive to the Noisy Miner (Table 5.1). The miners were also observed feeding on psyllids but, in contrast to the Spotted Pardalote, mainly took the lerp, leaving the insect lying beneath unharmed. Plots containing the most Spotted Pardalotes, Striated Pardalotes and White-plumed Honeyeaters and least Noisy Miners had the lowest frequency of leaf damage.

Different bird species usually select differing insect prey and occupy different feeding niches as a means of cohabitation (e.g. Gilmore 1985, Loyn 1985, Recher & Holmes 1985). Predator and prey abundances and feeding activity patterns constantly fluctuate. Healthy stands of River Red Gums with broad food and feeding niche diversity support the broadest foliage bird diversity. Other important foliage birds observed in the forest, woodland and unfragmented open woodland plots included the Musk, Purple-crowned and Little lorikeets, Eastern Rosella, Fan-tailed Cuckoo, Shining Bronze-Cuckoo, Tree Martin, Rufous Whistler, Grey Shrike-thrush, Black-faced Cuckoo-shrike, Crested Shrike-tit, Striated Thornbill, White-winged Triller, Rufous Songlark, Dusky Woodswallow and Olive-backed Oriole.

All, with the exception of the parrots and possibly the martin, feed on Gum-leaf Skeletoniser larvae. Invertebrates gleaned from the leaves by the lorikeets, rosella and Crested Shrike-tit were composed of psyllids, scale-insects (*Eriococcus* spp.) and the larvae of gall-forming wasps. The Tree Martin predominantly fed on flying insects, particularly moths (including adult skeletonisers). The thornbill fed mainly on psyllids and leaf beetles (weevils and chrysomelids). The whistler, triller and shrike-thrush took a large proportion of leaf beetles. The cuckoo-shrike took sawfly larvae (*Perga* sp.) and adult moths and leaf beetles. Crested Shrike-tits also occasionally took leaf beetles. Sacred Kingfishers and Dusky Woodswallows frequently took flying moths and beetles, particularly leaf defoliating scarabs. Red Wattlebirds were the only species observed taking adult Mottled Cup Moths (*Doratifera vulnerans*).

Other beneficial fauna

The River Red Gum area supports several beneficial ground-feeding birds. Pallid Cuckoos were observed taking larvae of the Dark-spotted Tiger Moth (*Spilosoma canescens*) from pasture grasses. Yellow-rumped Thornbills spent much time taking small insects from grasses. The Australian White and Straw-necked Ibis and Australian Magpies were observed feeding in pasture on grasshoppers, worms and the underground larvae of Christmas beetles and Pasture Grub Beetles (*Aphodius tasmaniae*). Long-billed Corellas were frequently seen digging for Common Onion-grass corms (a weed of poor pastures). Cockchafer beetle larvae were fed to their young during spring.

Bats are predators of nocturnal insects, many of which are not preyed upon by birds. Many of these species (particularly moths) have larval stages which defoliate leaves. The Freetail Bats occur almost exclusively in River Red Gums in Greater Melbourne. They also participate in gleaning psyllids from leaves (author pers. obs.). Bats, along with the lorikeets, rosella, kingfisher, martin, woodswallow and corella, nest in tree hollows. Long-term reduction of hollows in mature trees due to tree death may locally eliminate these beneficial species.

River Red Gum bird census—conclusions

Tree decline and dieback caused by insect leaf defoliation was found to be directly caused by decline in populations of foliage birds arising from tree clearing. When the foraging and breeding habitat of these birds becomes critically limited certain groups of invertebrates (notably insect foliage feeders) under favourable climatic conditions are able to build up populations to epidemic proportions which greatly exceed their food supplies (Morgan & Bungey 1981, Ford 1985). As dieback proceeds, conditions are provided which promote

harmful leaf defoliating insects (e.g. psyllids and skeletonisers) and discourage the foliage birds that regulate their populations. The level of foliage insect predation is diminished. These insects can then multiply and consume more leaves and dieback and tree death proceeds in an accelerating spiral known as a positive feedback condition (Heatwole & Lowman 1988).

Clearing decreases the number of nest sites for foliage birds and increases their exposure to predation from birds of prey and introduced mammals (Heatwole & Lowman 1988). Small foliage birds consume more insects as a proportion of their body weight than do larger birds. Studies by Hugh Ford and co-workers in northern New South Wales have shown that once flight distances between canopies increased beyond a certain critical distance and cover within canopies was opened up to below a critical level it became energetically uneconomic for small, density-dependent foliage gleaners such as the Spotted Pardalote to remain (Sandy Gilmore pers. comm.).

The Plenty Valley census study found that where trees had been cleared to densities of fewer than 10 per hectare (heavily cleared treed farmland plots) most density-dependent foliage species were absent and the rate of insect leaf damage was high. Any regulating influence that foliage birds may have had over the abundance of insect leaf defoliators was lost. Ground feeding birds adapted to exposed conditions in pastoral environments were dominant at these plots. These included the native Noisy Miner and the introduced Common Starling and Common Myna. These species exclude smaller, less aggressive species by out-competing them for limited resources such as food supplies or nest hollows.

In NEM the Spotted Pardalote breeds mainly among forest and shrubland in burrows in creek banks, earth-mounds and hill-slopes. Breeding has been observed only occasionally among the River Red Gums on the Plenty Volcanic Plains. Streams in this area generally lack adequate tree and tall shrub cover as a result of clearing and livestock grazing. Stock trampling has led to slumping and excessive weed growth on the stream banks. The loss of breeding and feeding habitat through tree clearing and stand fragmentation has greatly reduced the population of resident Spotted Pardalotes in the River Red Gum area.

In thinned or fragmented stands on farmland or remnants in urban areas the Spotted Pardalote is predominantly a non-breeding winter visitor. The construction of barrel-drains has depleted or eliminated its breeding habitat along creek banks in urban areas. The Plenty Valley census study found that large, mobile flocks of pardalotes were present in the fragmented stands of forest and unfragmented stands of open woodland during late spring. They seldom entered fragmented stands and never entered treed farmland. Small breeding populations were located along the creeks but most of the pardalote population was non-breeding.

RED IRONBARK AND YELLOW GUM BIRD CENSUS

In North East Melbourne, most stands of Red Ironbark were felled by miners between 1855 and 1890. Ironbarks occur in auriferous country and the timber was used for poppet heads and timber shoring in mine shafts and furnaces at steel foundries. Red Ironbark was also sought for sleepers and posts and was selectively logged or cleared over the following 70 years. Over the last two decades in NEM these rates have declined but most remaining stands are near settlement or in the path of proposed settlement. Over this period there has been noticeable decline in the vigour of Red Ironbarks due to the long-term cumulative effect of stress caused by tree thinning and stand fragmentation.

Leaf defoliation caused by high population levels of Gum-leaf Skeletonisers and psyllids has occurred (see River Red Gum Bird Census for discussion of cause and effect). Despite apparent food availability, populations of forest-dependent insectivorous birds (particularly cuckoos, Striated Thornbills and Spotted Pardalotes) controlling these insects have declined. This is due to loss of breeding/foraging habitat (both understorey and canopy foliage) and competition with birds adapted to forest fragmentation.

Stand fragmentation and thinning by clearing and urban encroachment and degradation by livestock grazing, weed invasion and earthworks have caused a decline in the health of Red Ironbark box-ironbark forests and woodlands in NEM. Red Ironbarks in fragmented stands have irregular and lower rates of blossom production and reduced nectar flows. Severe insect defoliation and dieback has been observed and stands support fewer foliage insectivores. Some stands support large populations of edge-inhabiting species such as Noisy Miners which compete aggressively and exclude insectivores and nectivores. This provides inadequate leaf area for photosynthesis and reduces the rates of food production, growth and flowering (Heatwole & Lowman 1988). Repeated defoliation exhausts the reserves of stored food (starch) in the roots. If the tree runs low in these stores it is unable to produce adequate leaves and, in extreme circumstances, will die.

Flowering and nectar secretion largely depend on the physiological state of the plant (Huber 1956). Trees under stress such as that caused by continual leaf defoliation by insects have depressed rates of flower and nectar production. As a result, the populations of several species of avian nectivores of Red Ironbark have declined substantially and the period between visitations of several nomadic and migratory species has broadened. Some of these species will not enter small, fragmented stands of bushland.

In NEM, much of the Yellow Gum box-ironbark woodland, like the Red Ironbark, is on private land and subject to increased pressure from housing development. Across the state most Yellow Gum woodlands are degraded by agriculture or utilised for hardwood production. As a result, stands have become thinned or fragmented and the understoreys have been invaded by weeds. Many of these stands are composed of stressed, senescing trees in farmland and towns or are immature regrowth. They support large populations of edge-inhabiting birds.

In stands that have been substantially modified, the environmental cues (e.g. rainfall, temperature and time of day) which regulate natural nectar secretion rhythms, appear to have been thrown out of balance. In both Red Ironbarks and Yellow Gums, bud initiation occurs during an active growth phase in spring. Heavy initiation occurs in wet years. Under optimal conditions (governed by rainfall and temperature) buds take six to nine months to develop and usually another 12 months before they can flower. A single branch of a Yellow Gum (and more often the whole tree) can flower every second year. Red Ironbarks have a more complex inter-relationship with their environment. Flowering is depressed for two years and gradually increases over subsequent years until seasonal conditions become optimal and prolific flowering occurs as a response.

Flower development beyond the bud stage is also promoted by heavy rainfall between late winter and early summer at the time of a major foliage growth phase. The longer the period of rainfall the more extensive the development (e.g. 1975/76). If this is followed by dry and sunny conditions in late summer-autumn (as experienced during droughts) large accumulations of starch (photosynthates) occur in the roots. Hydrolysis of starch into sugars is required immediately prior to flowering for nectar to be produced (Brimblecombe 1946). For prolific flowering to occur in Red Ironbarks there needs to be two successive years of optimal conditions.

In summary the requirement is:

- Year 1; high winter/spring rainfall (extensive leaf growth and bud initiation) and dry summer (extensive starch accumulation).
- Year 2; high winter/spring rainfall (extensive production of leaves and developing flowers), dry summer (high rate of photosynthesis and starch accumulation) and cool, wet late autumn (prolific flower production and nectar flow).

Prolific flowering/nectar production requires cool, sunny and dry conditions over late summer–early autumn which inhibit foliage growth and maximise the rate of photosynthesis (e.g. 1977, 1984, 1988). Rain and low temperatures in late May/early June, prior to main flowering and then a few sunny and warm days in late June ‘top-up’ flowering/nectar production (e.g. 1977). Heavy rains and warm temperatures in late summer–early autumn cause a new growth phase, burning up starch accumulations as they are remobilised into sugars and causing loss of flowering/nectar production (Porter 1978). This process also occurs if extensive insect defoliation occurs in summer–autumn. In fragmented stands there are positive feedback conditions. These occur when heavy rain in spring and autumn enabling foliage growth, leads to skeletoniser outbreaks, and dry, warm summers enabling food production lead to psyllid outbreaks. This is the scenario behind the loss of flowering/nectar production at Haleys Gully Road Hurstbridge.

Ecological studies of honeyeaters have found that co-occurring, congeneric species avoid competition by altering their foraging behaviour and partitioning their use of critical habitat resources (e.g. Recher 1971, 1981), Keast (1968b), Ford and Paton (1976, 1977 and 1982) and Pyke (1980, 1983). Each closely related species within each genus differs in a fundamental aspect in its feeding ecology (e.g. foraging behaviour and site or food preference). Many species of honeyeaters and lorikeets are nomadic or migratory and may move long distances in the pursuit of nectar and pollen (Keast 1968a). The three groups of small and medium-sized honeyeaters are the Melithreptids, Phylidonyrids and Lichenostomids. The Melithreptid and Phylidonyrids are nectar-dependent (at least for the times of the year when nectar is freely available). At these times they are limited by the distribution of nectar and may range widely in their searches for it. The Phylidonyrids take insects predominantly by hawking them from the air after sallies from a vantage point or while moving over flowers. When feeding on insects the three species (Crescent, New Holland and Tawny-crowned Honeyeaters) occupy different vegetation types and strata.

Within the Melithreptids, the White-naped and Brown-headed Honeyeaters forage in differing tree strata for nectar and insects, the latter taken almost exclusively by gleaning from foliage, branches and flowers (Recher 1981). The Lichenostomids are predominantly insectivorous and may be limited by the abundance of insects rather than nectar (Pyke 1983). Insects are more random and limited in distribution than nectar. When similar-size members of the Lichenostomid group co-occur (e.g. White-eared, Fuscous and Yellow-tufted Honeyeaters), they partition the vegetation strata vertically and have widely differing foraging strategies and diets (Ford & Paton 1976). The sedentary Lichenostomids (e.g. White-plumed Honeyeater) are generally more territorial and aggressive, particularly when food is scarce. As a result, they have become more specialised in their insectivory, relying heavily on leaf psyllids and scale insects. A few members of the group are strongly nectar-dependent and as a consequence move nomadically (e.g. Regent Honeyeater).

Honeyeater census methods

A long-term census study of avian nectivores has been conducted in 2 ha plots amongst a stand of Red Ironbark box–ironbark woodland (12.1) at Haleys Gully Road Hurstbridge and in the Long Creek headwaters at Smiths Gully, a mixed stand of Red Ironbark–Yellow Gum box–ironbark woodland (12.2) in the Plenty Gorge at Yarrambat and a stand of Yellow Gum box–ironbark woodland (12.3) at Plenty. Annual bird counts were conducted from 1977 to 1991. Nectar secretion and blossom production rates and the number of trees in flower were also recorded.

The aim of the study was to assess the stand characteristics which determine the rates of usage, foraging behaviours, feeding patterns and degree of interspecific competition occurring amongst nectivorous birds. Declining rates in nectar and flower production, tree vigour and nectivore usage were detected at each census plot. Populations in all three honeyeater groups declined dramatically at Hurstbridge. Declines in the populations of Melithreptids and Meliphagids occurred at Yarrambat while a decline in the lorikeets and

increase in Swift Parrots occurred at Plenty. The populations of edge-inhabiting species such as miners, wattlebirds and the White-plumed Honeyeater increased at each plot.

Annual 20-minute counts of nectivores (honeyeaters and nectar feeding parrots and lorikeets) were made in June at each plot. The times of the Red Ironbark counts were 0900 to 0920 hours at Smiths Gully, 0940 to 1000 hours at Hurstbridge and 1020 to 1040 hours at Yarrambat. Yellow Gum counts at Plenty were made four to six weeks later, in late July, at 1000 hours. The number of Red Ironbarks and/or Yellow Gums exceeding 30 cm in diameter that contained at least 1000 blossoms were counted each year. A large and vigorous Red Ironbark reference tree at Smiths Gully and Hurstbridge, a Yellow Gum at Plenty and a Red Ironbark and Yellow Gum at Yarrambat, was selected in each plot.

Nectar secretion and blossom rates of these trees were recorded. Nectar was extracted from the nectary of 10 flowers through a 1 ml glass microcapillary. The rate of nectar production for the 10 flowers was averaged. The flowers were on a mid-level branch in direct sunlight and were netted the previous afternoon to prevent nectivore entry. The rate of leaf damage caused by invertebrates was assessed during each census. To quantify invertebrate leaf damage 10 leaves were randomly collected from the mid-canopy of the reference tree at each plot. The area of damage on each leaf was then visually scored in 10 percentiles. Foliage loss was measured by scoring the projected canopy cover from 0 (full crowned canopy) to 10 (completely dead). The dieback/epicormic growth rate of five mature trees in the census plot was scored from 0 to 10. Each year all these data were then averaged for a final determination of mean tree vigour in each plot.

Full daylight counts of nectivores and measurements of nectar production were conducted at each reference tree (the largest tree occurring in its respective stand) in 1977. This was a prolific flowering year and each tree was in full flower. Each was selected on the basis that it attracted large numbers of birds. All nectar-feeding honeyeaters and parrots in the tree were counted over a 5-minute period at 30-minute intervals throughout the day. The rate of nectar production was measured at the end of each count, using the previously described methods.

Results

(see Red Ironbark nectarfauna census under site 40 (Yarrambat) and Yellow Gum nectarfauna census under site 42 Plenty–Janefield for further discussion)

Weather conditions govern the rates of nectar production of plants (Huber 1956). This then governs the rates of usage by nectar feeders. Nectar sugars are a product of photosynthesis (e.g. Shuel 1955). The sugar content and amount of nectar fluctuates according to temperature and wind (Huber 1956). Nectar quickly evaporates in the nectary in high winds or temperatures. The study was run under uniform and optimum conditions. Counts were conducted on days that were sunny and calm, with a daily maximum temperature of approximately 15°C.

Prolific flowering and nectar flow in the district was found to occur at intervals of five to six years in the Red Ironbarks and two to three years in the Yellow Gums. These years are more erratic for Red Ironbarks than for Yellow Gums and include 1977, 1983 and 1988. In intervening (poor) years the nectar/flowering rates decreased. The years 1992–96 since the conclusion of the study have each seen poor flowering. The year following a heavy year, rates were down by 20% and in subsequent years they approximately halved. This variability in rates greatly affects the movements of honeyeaters, possibly altering the migratory patterns of some (Keast 1968a). For example, in prolific years the Yellow-faced Honeyeater overwinters instead of moving north and the Fuscous and Black-chinned Honeyeaters arrive from the inland. These years attract large numbers of birds. Comparisons were made of data from prolific years and poor years within and between census plots.

Both the Red Ironbark and Yellow Gum are winter flowering and provide abundant sources of sugar (nectar) and less abundant (though relatively high for the district and season) sources of protein (insects) for birds. Pollination of both tree species is largely dependent on birds as insect activity at this time of year is reduced. Many of the smaller honeyeaters (e.g. Melithreptids) consume large quantities of nectar because they burn up relatively higher amounts of energy than the larger honeyeaters. Both eucalypt species produce heavy

nectar flows (compared with summer flowering species in the district which rely more on insect pollination) and as a consequence attract large numbers of nectivorous birds.

Full daylight counts of nectivores and measurements of nectar production were conducted in 1977. A relationship between nectar secretion and the pollination strategies of eucalypts has previously been determined by Ibrahim and Salim (1962). The present study revealed that the daily nectar secretion cycle of Red Ironbarks and Yellow Gums had pronounced and differing endogenous rhythms. These are geared to the periods of intense feeding activity of small nectivorous birds, particularly the Melithreptid honeyeaters. In the mixed stand at Yarrambat, Red Ironbarks have a mid-morning peak (0900–1030 hours) in nectar production and nectivore usage. Yellow Gums produce nectar at a constant rate through the day, but mainly attracted nectivores during the mid to late afternoon.

During the morning peak of Red Ironbarks, as well as there being more species of honeyeaters present, the number of individuals of some species (particularly the Melithreptids, White-naped Honeyeater and Brown-headed Honeyeater) increase sharply. These two species are highly mobile and are able to switch to alternative food sources and arrive suddenly as it becomes available and depart just as quickly when it becomes depleted (Ford & Paton 1977, Recher 1981). They are able to exploit patchy or periodic food resources by recognising these cyclic peaks, which improves their foraging efficiency. Cyclic and precisely timed daily nectar peaks increase the chance of visitation by nectivores and hence the chance of pollination of the trees. In years when abundant blossom is present on the Yellow Gums, when in association with Red Ironbarks at Yarrambat, the net accumulation of nectar in the blossom nectaries stimulate a late afternoon feeding foray of all the nectivores. The nectaries of Red Ironbarks become dry at this time of day.

CHAPTER 6

RESULTS OF HABITAT AND FAUNAL ASSESSMENT

HABITATS

The habitat classification given at the beginning of each volume was derived from extensive field survey. With few exceptions (see below), the nomenclature for the habitat classification system follows the vegetation communities and sub-communities described for the Melbourne Area by Cheal *et al.* (in prep.), SGAP (1991) and Robinson (1992).

The wetland classification follows that of Schulz *et al.* (1991), which was adapted from Corrick (1982) and Norman and Corrick (1988). The wetland habitat types have been broadly grouped as permanent wetland and seasonal wetland.

Appendix 1.1 (which is folded into the pocket at the back of the present volume) presents a summary of the habitat types occurring in NEM, along with their conservation status in Victoria, Greater Melbourne and North East Melbourne, their distribution, major landform, geological and soil types and their rainfall and elevation range. On the back of this summary is a discussion of the 29 plant communities.

The Victorian conservation status of habitats is categorised under the system devised by Frood and Calder (1987). Four conservation categories of plant dominance associations (vegetation types in this report) and alliances (habitats in this report) were devised. In order of highest to lowest risk these are:

- Category 1: Conservation measures urgently required, particularly refugias. Category 1 habitats are regarded as threatened in Greater Melbourne and generally regarded as threatened in Victoria;
- Category 2: Further conservation measures in high need;
- Category 3: Conservation measures required;
- Category 4: Additional features requiring conservation measures.

Habitats in GM are placed into four categories. In order of highest to lowest risk these are:

- 1 Threatened: a habitat that has been eliminated or degraded in over 75% of its natural range in GM. Threatened habitats of the lowlands largely contain a grassland-dominated field layer and occupy soils of higher nutrient status and moisture level. They have been selectively cleared for settlement and agriculture and are poorly represented in the biological reserve system;
- 2 Depleted: a habitat that has been eliminated or degraded in 50% to 75% of its natural range in GM. It is inadequately represented in the biological reserve system;
- 3 Disjunct: a stand of habitat separated either naturally or through clearing by a distance considered to exceed that required for genetic contact, apart from through chance events. Stands are usually small and often support remnant populations which convey important biogeographic information. Many habitats that are disjunct, while rare, are not threatened; often the topographic feature making them rare has preserved them (e.g. river cliff);
- 4 Secure: a habitat still occurring in over 75% of its natural range in GM and contained in substantially intact condition in over 50% of this range. It is adequately represented in the biological reserve system.

Common names of plants follow the Flora 1996 (NRE flora information system) which has been adapted from Willis (1970 and 1972). Scientific names follow Ross (1990), and are used where no common name is available for a species (e.g. recently described plants).

A total of 71 habitat types has been identified. Conservation measures are urgently required at the State level for 20 of these, and further conservation measures are in high need for another four. There are 51 habitat types considered threatened or disjunct in Greater Melbourne, 12 are depleted, and only seven are considered secure. In terms of reservation status in NEM, 29 are inadequately reserved, and of these 24 face high threats.

Such figures indicate that much greater efforts are required to ensure the long-term viability of these habitat types and the fauna that inhabit them.

Habitat significance

Assessing habitat significance is a departure from traditional methods of assessing botanical significance. This has been developed specifically for the NEROC study. No comparable survey and assessment has been conducted previously in Victoria. Within the context of Greater Melbourne (GM), the occurrence of habitats, plant species and other botanical features is classified as being of Very High, High or Medium significance.

Very High

Includes multiple reference stands or areas supporting an endangered or multiple vulnerable species, very high species diversity or other botanical attributes potentially of national significance.

High

Includes one reference stand or areas supporting a vulnerable or multiple rare species, high species diversity or other botanical attributes potentially of state significance.

Medium

Includes relatively intact and extensive stands and some partially intact or small stands or areas supporting rare species, medium species diversity or other botanical attributes potentially of regional significance.

There are three conservation status categories designated within each level of habitat significance: Categories 1, 2 and 3 from highest to lowest importance. As a rule of thumb, Very High, Category 1 supports most if not all of the above mentioned attributes, Category 2 supports some and Category 3 supports one.

Qualitative assessments of stand naturalness consist of four levels: reference stands; relatively intact and extensive stands; partially intact or small stands; and remnant, degraded or establishing stands. Reference stands are defined as one of the most intact (and often most extensive) stands of a habitat known to remain in NEM. Distributions shown under habitat at the beginning of Volumes 2–6 are based on topographic 1' latitude X 1' longitude grids.

Rare or threatened plants in Victoria (VROT) following NRE (1996) are listed. 'Threatened' is equivalent to endangered or vulnerable taxa. Species entered under 'rare' also include those listed as depleted, poorly known or potentially threatened in Victoria.

Flora/habitat values generally equivalent to state or higher botanical significance are discussed under critical assemblages or populations. Those of regional or sometimes lower significance are discussed under notable features.

The habitats of North East Melbourne

The critical series of sites of significance identified in the NEROC study are proposed as Ecological Reference Areas, Critical Conservation Areas and Strategic Habitat Links. A companion flora, vegetation community and botanical significance study of these areas is being conducted. This is planned to be produced as an ecological monograph series of seven volumes. Volume 1: Flora, Vegetation Community Survey and Sites of Botanical Significance of Plenty Gorge Park is currently being prepared (Beardsell, in prep.). This contains detailed methodology, community descriptions, sites of botanical significance, management, rare or threatened plant texts and flora lists.

A summary of results of the flora/vegetation community survey has been provided under habitat significance for each site in this report.

Vegetation communities and sub-communities for regional studies of the Melbourne area have been described by several authors (e.g. LCC 1991, Robinson 1992, SGAP 1993 and Cheal *et al.* unpub.). Communities have also been described by other authors in local flora studies and management plans for areas including Plenty Gorge Park (Carr *et al.* 1991), Merri Creek (Frood 1992), Dunmoochin (Ecological Horticulture in prep.) and Kinglake NP (CNR 1996). Over the last decade, vegetation classification

terminology has undergone major revision. The NRE Flora Survey Branch has determined Ecological Vegetation Classes (EVCs) for central Victoria. The levels are broader than communities and are designed for broad-scale vegetation mapping exercises.

Where applicable, community nomenclature follows the EVC system. Several modifications and additional localised communities were recognised during intensive field surveys of NEM. The status of 'habitat' in this study is loosely referable to that of sub-community in flora studies. However, it has been redefined to correlate with landform and faunal species distribution. This has involved lumping some floristic sub-communities (e.g. plains grassland). Seventy-one habitats within 29 plant communities are recognised in NEM (Appendix 1.1). Several are new for the study area and some are of minor natural occurrence or have been reduced to refugial stands by land settlement.

The classification was determined by hand-sorting field data into natural groupings. Floristic and structural information was important for determining communities while landform and biogeographic (plant and animal) indicator species were important for determining habitats. Plant common name nomenclature and conservation status follows NRE (1996) and Walsh and Entwisle (1994 and 1996). See Appendix 1.1 for a detailed account.

FAUNA

Over 50 000 fauna records were obtained in NEM over the period from 1986 to 1996.

The fauna comprised 322 species of native non-marine terrestrial vertebrate species including 230 birds (71% of the state bird fauna), 42 mammals (60% of the state mammal fauna), 36 reptiles (33% of the state reptile fauna) and 14 frogs (47% of the state frog fauna). Twenty-two species are established aliens. A full list of species is provided in Appendix 1.3, together with information on their conservation status, distribution and the habitat types in which they are found.

Seven native bird species recorded from 1970 to 1986 are considered vagrant to NEM.

The watercourses and waterbodies of NEM (including the Yarra River to downstream of Dights Falls) contain 14 species of native freshwater fish and a further 12 introduced species (four native to other parts of Victoria and eight native to other parts of the world). The water of the Yarra River system upstream of the falls contains more introduced species than native species (11 and 10 species respectively).

Threatened fauna in Victoria

Populations of vertebrate species that naturally occur in NEM have declined substantially across the state. These are listed below with their conservation status in Victoria, based on the classification of CNR (1995). Vagrant species are not included in this analysis.

Four species are endangered, seven species are vulnerable, twenty species are rare, nine species are insufficiently known and four species are known to form restricted colonial breeding or roosting sites (See Appendix 1.1).

Five rare or threatened species of fish and a tortoise have been introduced.

The conservation status of butterflies follows Douglas (1995: three endangered, three vulnerable, two insufficiently known and two rare species were recorded in NEM).

CNR (1995) lists the Swift Parrot as endangered in Victoria. About 30 observations were made in NEM during the 1986–96 survey. Most were prior to 1993, when the species was listed vulnerable; only three observations were from 1993–1996. The total population and rate of sightings near Melbourne have declined significantly. In most areas where Swift Parrots were frequently observed prior to 1993, they have become rare or absent. The assessment criteria of sites is based on the significance of the parrot at the time of sighting. Contemporary sightings should be treated with the significance applied to nomadic/migratory endangered species such as the Regent Honeyeater.

Rare or threatened species in Victoria whose range or population in terms of survey sightings in NEM constitutes >50% of that for GM include: Lewin's Rail, Blue-billed Duck, Grey Goshawk, Barking Owl, Masked Owl, Sooty Owl, Red-tailed Black-Cockatoo, Swift Parrot, Regent Honeyeater, Spot-tailed Quoll, Brush-tailed Phascogale, Common Dunnart, Eastern Horseshoe-Bat, Common Bent-wing Bat, Large-footed Myotis, Eastern Broad-nosed Bat, Mountain Dragon, Tree Goanna, Glossy Grass Skink, Tasmanian Mudfish, Australian Grayling, Rare White-spot Skipper, Genoveva Azure, Small Ant-blue, Large Ant-blue, Eltham Copper, Yellow-spot Jewel, Ictinus Blue and Icilius Blue.

Regionally significant fauna in Greater Melbourne

Species that have a threatened conservation status in Australia or Victoria have been identified and given special consideration (see Criteria for Selecting Sites, Chapter 7). The database was reviewed and the conservation status of species in NEM was assessed (Appendix 1.2). Regionally threatened, rare or restricted species, the latter including those that have been substantially depleted or that have a naturally limited range in GM, have no statutory recognition in the context of their conservation status in Victoria. Populations of these species in GM have one or both of the following attributes:

- a declining range or declining populations within their present range;
- occupation of a habitat type(s) that is under-represented in the reserve system and/or subject to degrading land-use (i.e. threatened or depleted), particularly when in localised populations or habitat refugia.

The 'threatening processes' to these species include:

- habitat destruction, modification or fragmentation;
- predation by introduced animals;
- competition with introduced species and/or other native species;
- pollution or chemical poisoning; and
- human interference.

Regionally significant species include all of the Victorian threatened fauna and other species whose range has been substantially depleted or is naturally limited in GM. Regionally endangered species occur in 1–9 (< 1%) surveyed grids in GM; regionally vulnerable species largely occupy threatened or disjunct habitats and occur in 10–39 (1–5%) surveyed grids in GM. Regionally rare species that largely occupy non-threatened habitats occur in 10–39 (1–5%) surveyed grids in GM; regionally depleted species largely occupy threatened or disjunct habitats and occur in 40–79 (5–10%) surveyed grids in GM. Regionally restricted species largely occupy non-threatened habitats and occur in 40–79 (5–10%) surveyed grids in GM. Regionally endangered or vulnerable species have been substantially depleted or eliminated from over 75% of their natural range (or

have a naturally limited range) in GM. Regionally depleted species have been substantially depleted or eliminated from between 50% and 75% of their natural range (or have a naturally limited range) in GM. Regionally rare or restricted species are still considered secure in over 50% of their range (or have a naturally limited range) in GM.

Extinct birds in North East Melbourne since Settlement

Emu (1850s), Bush Stone-curlew (1940s; widespread; vagrant seen at St Andrews in 1993); Australian Bustard (no record; likely on alluvial plains mid-1800s); Magpie Goose (no record; likely on alluvial plains mid-1800s); Cape Barren Goose (ceased visiting NEM on an annual basis after the 1950s; vagrants occasionally seen such as in 1982 at Doreen); Turquoise Parrot (no historical literature record for GM, but a possibility as its range contracted in Victoria in the nineteenth century due to land clearing; a road-kill vagrant was taken at St Andrews north in 1986); Superb Parrot (1940s; Wollert and Yarra Bend); Grey-crowned Babbler (1940s; Wollert and Plenty Gorge); White-browed Babbler (probably once present in areas such as the Plenty Gorge; last seen in GM at Gellibrand Hill in 1986); Blue-faced Honeyeater (last seen 1975; Epping North); and Major Mitchell Cockatoo (last seen 1983; Quarry Hill). Some of these entries are based on literature from elsewhere in GM.

Extinct mammals in North East Melbourne since settlement

Eastern Quoll (1940s; widespread); Eastern Barred Bandicoot (1930s; Craigieburn and Plenty Gorge); Southern Brown Bandicoot (present in Kinglake NP; likely originally present at Yering Flats in the Yarra Lowland Hills but became extinct in the Nineteenth Century); Long-nosed Potoroo (no records; unconfirmed reports indicate its presence in the ranges); Rufous Bettong (no record; possibly in foothills in mid-1800s); Tasmanian Bettong (historical record from Wallan in Menkhorst 1995; probably widespread in grasslands and grassy woodland on volcanic and alluvial plains in 1840s); Broad-toothed Rat (no record; not trapped but possibly occurring in ranges); White-footed Rabbit-rat (no record; likely on volcanic plains in 1840s); Plains Rat (no record; likely on volcanic plains in 1840s); and Squirrel Glider (no record; may occur in foothills). Apart from the first two, all are based on literature from elsewhere in GM.

No reptile or frog species are known to be extinct in NEM, though the Southern Lined Earless Dragon is apparently near extinction. It is considered that the rare Swamp Skink would have been likely to have occurred along the Yarra River. It may persist at Yering Backswamp. Pitfall trapping should be conducted at this locality.

CHAPTER 7

SELECTING THE SITES OF SIGNIFICANCE

CRITERIA FOR SELECTING SITES

The context of Greater Melbourne (GM)

Victoria supports 400 native (marine and non-marine) bird, 71 native non-marine mammal, 105 native non-marine reptile and 32 native frog species. In GM (an area of 10 000 km² or 5% of Victoria), 335 [XX] native bird species (84% of the Victorian fauna), 48 native non-marine mammal species (68% of the Victorian fauna) and 53 native non-marine reptile and frog species (38% of the Victorian fauna) have been recorded. GM contains the most diverse assemblage of birds and mammals for any other comparably sized region within the state. In a state-wide context, the diversity of threatened (CONCOM in prep., CNR 1995) native fauna that occurs in GM is relatively high and most areas supporting intact or extensive stands of native habitat are of high significance. In addition, GM contains the most compact and diverse system of threatened habitats in Victoria.

The context of North East Melbourne (NEM)

Faunal survey using a uniform methodology has been completed for each of the regions of GM (see Mansergh *et al.* 1989, Schulz *et al.* 1991, Brereton *et al.* in prep.). See Fauna Chapter 6.

Coverage and search effort

Approaches to identifying 'sites of significance' vary widely, depending substantially on the type of feature/fauna being considered and the amount of quantitative data that has been gathered. In the NEROC study a systematic and standardised coverage and search effort was conducted in the representative habitat types in each site. All terrestrial vertebrate groups were sampled as evenly and thoroughly as possible and most sites were surveyed extensively and intensively (see Survey Techniques in Chapter 3). Most sites contain at least one 1' latitude x 1' longitude grid (1' grid) in which mammal trapping and at least eight hours search spread over two or more seasons was conducted for each vertebrate group. Extensive plant, habitat, invertebrate and physical information was also gathered. Each of these grids has received a sufficiently high coverage and search effort to enable a comparative analysis within NEM and to other parts of GM and Victoria. The end result of this survey effort, it is hoped, is tenable strategies and sustainable recommendations.

A comprehensive key to the assessment of significance criteria was developed for the field survey methodology of the NEROC study. This key bases value assessments of the biological significance of a site on the significant animal and plant groups identified. These groups were then intensively and extensively surveyed and researched. It is stated in the key if an assemblage was insufficiently surveyed to assess a significance value. The NEROC report establishes the standards for the best possible scenario for habitat and fauna conservation. This information is presented for planners to consider in future land-use decisions. The philosophy of the report is to raise awareness of potential conflicts so that land-use and management decisions can be formulated with safeguards for natural ecosystems. Awareness can resolve many possible conflicts which, if overlooked, could often become unresolvable problems.

Ethics and conservation

In this study the sites and key fauna/flora groups were surveyed intensively and at an optimal time of year. As a result many species were recorded which can be overlooked in fast-track surveys (e.g. orchids and butterflies). Many recent assessments of sites of significance near Melbourne have been based on fast track survey under inadequate funding and unrealistic timelines. This resulted in information and species being overlooked, sites being determined with lower significance, habitat being destroyed and critical conservation and planning considerations being avoided. Survey data was not of an appropriate standard to determine the likely critical values or assess their indicative significance. In many instances 'value judgements' were based on cursory survey (often under sub-optimal operating conditions such as poor timing). If key values of an area are likely to be species such as butterflies or orchids, effective research and survey is essential. Survey for orchids or butterflies requires several weeks field effort spread over six to 12 months.

In most instances the presentations failed to acknowledge existing biological values and failed to assess the potential for these values to decline as a result of the proposal. Downgrading the significance circumvents the requirement for appropriate conservation safeguards, follow-up rehabilitation and acceptance of responsibility for environmental damage. The presentations lack the data to establish a tenable assessment criteria. Many reflect a negative and ambiguous assessment, usually to the effect that the site has an 'apparent lack of values'. Seldom is this placed in a context of how comprehensively or competently these 'values' were surveyed. They lack a concluding statement that surveys for likely significant flora and fauna assemblages (e.g. threatened species, bats, butterflies) were not undertaken and that these values were unassessed. Conflict invariably arises as the indicative biological values come to light. This is seldom in the best interest of conservation or development.

Development and conservation both win when solid biological research accompanies a tenable environmental impact assessment. Incremental loss of bushland refugias to development and associated disturbance is occurring throughout the urban/bushland interface of NEM. The bushland fauna is being displaced by urban fauna and the refugias are becoming small, degraded, disturbed and highly fragmented. Eucalyptus dieback is widespread in these areas and their diminishing biological values are documented throughout this report. These issues must be fully addressed.

The philosophy of proceeding with development in significant or sensitive areas is comparable to mining under the foundations of a bridge. However, the philosophy looks after 'assets' such as bridges that cost money to build or replace (hence of social significance or of economic value). They are preserved and maintained because they are 'needed'. The philosophy apparently places a lower value on things that come free (the flora and fauna, the forests, the water etc.). The NEROC report aims to encourage an understanding that society needs natural ecosystems as much as it needs bridges.

Criteria for assessing sites of biological significance

Biological significance can be defined, approached or derived in different ways. Looking back from today's standards of species rarity and representativeness would determine most 'sites' in Australia to be nationally significant at the time of European contact. They more than likely supported species that are now extinct or endangered or other values now regarded as highly significant. The few areas that are substantially intact today have retained this significance and most of the others have declined relative to their ability to withstand the impact of threatening processes.

Looking forward using contact standards would probably determine most of today's 'sites' in Australia as being of low significance on account of the widespread and broadscale extinction and depletion of species that has occurred over the 200 years. Extinct and endangered species, most other indigenous species and other values now regarded as highly significant, were more widespread and common. As these species and values fell to widespread threatening processes, the few sites retaining them became more significant relative to those that did not.

A synthesis of both approaches was used in determining the sites of significance. There is a paradox in that some sites on the settled hills and plains contain both the most threatened species and the most threatening processes. Some (such as the Plenty Gorge Yarrambat–Morang Wetlands) which have been

subjected to disturbance and modification by humans, still support the highest faunal significance rankings. Sites of national or very high significance are those which have coped best with these threatening processes over the long haul. However, these sites and their threatened species call a warning for protection and active management as both are approaching the fine line between gaining significance by virtue of rarity and losing significance due to elimination of these species and values.

A further problem is that the most threatened species occur in the most threatened habitats. The threatening processes operating on these species/habitats are numerous, incremental and widespread, usually state-wide and often nation-wide. As an example, the nation-wide status of the Regent Honeyeater has declined alarmingly over the last decade and it has become one of the two most threatened faunal species occurring in NEM. Consequently, the faunal significance of the Plenty Gorge Yarrambat–Morang Wetlands site has risen from state to national despite declines in the rate of Regent Honeyeater visitations, overall fauna populations and habitat quantity and quality. Similarly, the Merri Creek–Bald Hill site was not nationally significant in the recent past and probably will not be in the near future (particularly given the likelihood of ongoing poor management). At the moment, as long as the Earless Dragon survives, it is national. Sites with endangered species such as the Regent Honeyeater and Earless Dragon that still rank highly in most other aspects of faunal significance (e.g. Plenty Gorge Yarrambat–Morang Wetlands) are consequently the most important to conserve and protect.

This study is the first of its type to survey, assess and integrate the significance of the fauna and habitat of a region. A key assessment criteria system of the biological values of sites has been developed so that a rational allocation of resources and management can be made. The habitat significance of all blocks within the study area was assessed following a key assessment criteria system of the biological values.

The assessments are indicative of the rate or integrity of measured and defined biological parameters in the context of their known distribution and conservation status. They are theoretically independent of land-use (e.g. reserve or open space, residential land or farmland) and land ownership (e.g. public or private).

As a result of extensive modification of the landscape associated with European settlement it should be inferred that *all* remaining native vegetation and wildlife habitat in Victoria (but more acutely the remnant vegetation of the lowlands) can be considered significant for the conservation of indigenous flora and fauna. There are many pressures and demands placed on these remnants and the resources available for their management. It has become necessary to establish priorities for the protection and management of particularly significant values.

Accepted criteria for assessing biological significance generally address:

- 1 Species and community rarity
- 2 Species and community richness
- 3 Representativeness of type
- 4 Population density and abundance
- 5 Scientific and educational value

These criteria follow the principle objectives of nature conservation: maintenance of populations, assemblages and species of native plants and animals; maintenance of the genetic resources they contain; maintenance of ecological communities and the interactions they comprise; and function of natural environmental and evolutionary processes within ecosystems. These have been adapted into the criteria used in this report (except for scientific and educational value, which appears in the site discussions).

HABITAT SIGNIFICANCE CRITERIA

The Flora Section of the Department of Conservation and Natural Resources (DCE 1990) developed the following criteria for assessing significance, this was modelled on the current approach adopted by the Australian Heritage Commission for the Register of the National Estate, . They have been adapted for this survey.

- 1 Rarity

Criterion 1: Importance for rare or threatened flora, vegetation community or other natural biotic phenomena

Conservation status of vascular plants in an Australian context is currently determined by reference to Briggs and Leigh (1988). Status in a Victorian context is by reference to Flora (1994): *Victorian Flora Species List* (October 1994 edition); Flora Section, Conservation and Natural Resources. Status in the regional (Greater Melbourne) context is determined through personal records, examination of the CNR Flora Information System Port Phillip database (Cheal *et al.*, unpub.) and reference to the database collated by Cliff Beaglehole during the Melbourne Study Area field survey (Beaglehole 1983; including personal communications with that author).

2 Richness and diversity

Criterion 2: Importance in exhibiting unusual richness or diversity of indigenous flora

The most commonly quantified and standardised assessment is per medium of vegetation quadrats. High plant diversity generally corresponds with high habitat diversity or heterogeneity. This is most pronounced in areas displaying strong physiographic gradients such as major stream valleys. Those such as the Yarra Valley also serve as a buffer from the effect of land settlement and environmental degradation.

3 Representativeness

Criterion 3: Importance in demonstrating the principal characteristics of the range of indigenous vegetation communities

In this study representativeness will frequently apply under Ecological Reference Areas and Critical Conservation Areas (Chapter 9). To be of very high habitat significance for representativeness the range, characteristics, variation and ecological amplitude of plant species or assemblages in a site is one of the broadest within its biophysical type in GM.

Representativeness can be quantified by uniform area surveys. The study area was divided into grids of 1' latitude x 1' longitude (area of approximately 2.2 square kilometres). This grid size is small enough to be exclusive to a local area but large enough to represent virtually the full range of local habitats. Assemblages of significant species represent the range of variation within vegetation communities. A systematic survey effort of these species was conducted over the grids. Diversity classes used in this study were derived from state-wide habitat and plant assemblage surveys conducted by the author. The classes enable regional comparisons between sites and a Victorian overview for the very high significance sites.

4 Population density and abundance

Criterion 4a: Importance in demonstrating existing ecological processes or natural systems

Criterion 4b: Importance in maintaining existing ecological processes at the regional to national scale

In this study, population abundance is reviewed under connectivity (see also Strategic Habitat Links in Chapter 11). Viability is an assessment of the extent (size) and intactness (naturalness) of a stand of vegetation or population of a species. Intactness is essentially an inverse measure of disturbance, either biotic (e.g. livestock grazing and weed invasion) or physical (e.g. drainage earthworks and vegetation clearing). Disturbance can be both direct (e.g. land clearing) or indirect (e.g. weed and vermin invasion), internal or external and current or potential. Intactness is a direct measure of vulnerability to disturbance (i.e. intact areas are in danger of losing more significant values through disturbance than degraded areas).

For habitats the criterion assesses both the extent over a given area and the intactness of integral structural and floristic components. Other factors such as rarity being equal, an extensive and intact stand has a more important role in the conservation of natural ecosystems (i.e. higher significance) than one that is not. In this study the most extensive and intact stands of threatened, depleted or disjunct habitats in NEM, or most significant populations of a rare or threatened species in Victoria, are largely contained within proposed Ecological Reference Areas or Critical Conservation Areas (Chapter 9). Population integrity and viability is

also assessed on other superlative features such as maturity, age and size class, vegetation succession or fire and land-use history.

To be of very high habitat significance for population integrity and viability a site supports one of the finest examples of pre-European settlement habitats within its biophysical type in Australia. Likewise, state significance occurs in the context of Victoria and regional significance occurs in the context of Greater Melbourne (GM). Biophysical types recognised in GM include marine (offshore and coastal), streams, alluvial floodplains, volcanic plains, natural waterbodies, foothills or ranges.

In areas meeting very high habitat significance, alteration and disturbance from humans has not significantly reduced the range of evolutionary potential amongst species. These stands are amongst the most natural and least disturbed by human activities compared to other occurrences within the biophysical type in Australia (and a corresponding context for areas of state and regional significance as preceding paragraph). In nationally significant areas, they may also provide unique or specific and essential habitat for a plant or animal species or assemblage in the context of Australia. This includes feeding and breeding sites and migration routes for relatively large populations of wildlife that are rare or threatened nationally (e.g. Swift Parrot). They may also provide habitat at a critical stage of their life cycle (Schulz *et al.* 1991).

5 Scientific and educational value

Criterion 5a: Importance for information contributing to wider understanding of natural history, by virtue of their use as research sites, significant Type localities, educational areas and reference or benchmark sites

Criterion 5b: Importance in demonstrating the evolution of indigenous flora and/or fauna

In this study scientific and educational value are reviewed under Critical Conservation Areas and Ecological Reference Areas (see also Criterion 1),.

FAUNAL SIGNIFICANCE CRITERIA

The key to the faunal significance assessment, which is presented in summary for each site, follows the same principles and criteria parameters as the habitat significance assessment. Areas of native vegetation not covered by a 'site of significance' are still important and should be retained wherever possible. In some instances they are unassessed because they were unable to be surveyed. Subspecies are included wherever the word 'species' is read in the following criteria.

Sites are classified as National, State or Regional in terms of faunal significance based on the criteria (e.g. B) and sub-criteria (e.g. b) discussed below. The assessment classes of faunal significance in this report are based on hand analysis of data (in excess of 100 000 records) systematically collected during the regional fauna surveys of GM (survey period 1986–1996). See Appendix 1.2 for a summary of the information given below.

National

The occurrence of an attribute contributes substantially to its conservation in Australia. These sites contain very high natural heritage values and it would be desirable on faunal conservation grounds if they were protected under Commonwealth government legislation.

State

The occurrence of an attribute contributes substantially to its conservation in Victoria but not necessarily Australia. These sites contain high natural heritage and conservation values and it would be desirable on faunal conservation grounds if they were protected under Victorian government legislative controls.

Regional

The occurrence of an attribute contributes substantially to its conservation in Greater Melbourne but not necessarily Victoria. The region in this study is defined as Greater Melbourne (GM) of which North East

Melbourne (NEM) is one of four study areas. These sites contain medium natural heritage and conservation values and it would be desirable on faunal conservation grounds if they were protected under local government conservation controls.

Sites are further ranked into one of three sub-criteria categories within their level of faunal significance.

Category 1 (> 25% of the sub-criteria):

4 or more national sub-criteria

9 or more state sub-criteria

12 or more regional sub-criteria

Category 2 (15% to 25% of the sub-criteria):

2–3 national sub-criteria

5–8 state sub-criteria

7–11 regional sub-criteria

Category 3 (< 15% of the sub-criteria):

1 national sub-criterion

1–4 state sub-criteria

1–6 regional sub-criteria

A. CITED ZOOLOGICAL SIGNIFICANCE

a. Cited zoological significance within the survey period by an accredited authority/study

B. RARITY: Rare or Threatened Fauna

These species are listed or proposed for listing (to be inferred in any relevant following criteria) by an accredited authority in Australia/Victoria. Unless otherwise stated for birds and fish, this only includes resident or breeding populations or repeated feeding or roosting observations of migratory/nomadic species in natural habitat. A 1' grid supports:

a. Endangered fauna. Species listed as endangered in Australia/Victoria.

National: 1 species listed in Australia

State: 1 species listed in Victoria

Regional: single sighting of a nomadic/migratory species listed in Australia or Victoria

b. Vulnerable fauna. Species listed as vulnerable in Australia/Victoria.

National: 2 species listed in Australia

State: 1 species listed in Australia

Regional: 1 species listed in Victoria or a single sighting of a migratory/nomadic bird or fish species listed in Australia

c. Rare fauna. Species listed as rare, potentially threatened, insufficiently known or indeterminate in Australia or Victoria (National not applicable).

State: 4 or more species (or breeding observations of two species).

Regional: from 1 to 3 species.

d. Extinct fauna. Species presumed extinct in Victoria or threatened in Victoria and presumed extinct in NEM.

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

Population census or trapping sites based on Australian Mapping Grid 100 m reference points are the most accurate expression of integral diversity as the survey effort was standardised. Area searches were usually conducted within two hours to over 5–20 ha. Selected points were determined by the place or time of optimal detectability of species and assemblages (e.g. factors influencing movement and behaviour patterns such as climate, food availability, breeding season/availability). The diversity classes were derived from regional fauna surveys of Greater Melbourne. Once the classes were established, they were extrapolated to provide a State and National context (insufficient data were available to access the latter for many of the sub-criteria).

Before a site was surveyed intensively, an orientation survey determined the parameters present which qualified (or likely qualified) for the significance criteria. Survey effort in a site was hence proportional to the diversity of its qualifying parameters. This avoids the significance (or lack of significance) of a site reflecting survey effort (or lack of survey effort) rather than inherent richness (or lack of richness). Time and resources prevented the survey of most non-qualifying parameters. A repeatable, single season, standardised and intensive area/time search, census (<5 replicates and 8 hours total) or trapping, netting or electrofishing effort was conducted. A 1' grid supports:

a. International migratory waders. Area search for species including Latham's Snipe protected under international treaties such as JAMBA and CHAMBA; Schulz *et al.* (1991). These are spring–summer migrants from breeding grounds in the northern hemisphere. The Double-banded Plover is an autumn–winter migrant from New Zealand. While not protected under treaty, it is included as it has a relatively small total population and the wetlands of southern Australia are considered critical for the species in a global context.

National: from 10 to 14 species

State: from 5 to 9 species

Regional: from 2 to 4 species

b. Waterbirds. Area search on given day (non-passerines).

National: 40 or more species

State: from 30 to 39 species (or over 50 species in the 1986–1996 survey period)

Regional: from 20 to 29 species (or 30–49 species in the 1986–1996 survey period)

c. Breeding seabirds. Area search. (Not applicable to NEM.)

National: 15 or more species
State: from 7 to 14 species
Regional: from 4 to 6 species

d. Breeding waterfowl. Area search including grebes and Eurasian Coot.

National: 14 or more species
State: from 8 to 13 species (55–100% of this fauna of GM)
Regional: from 4 to 7 species (30–50% of this fauna of GM)

e. Honeyeaters. Census and area search excluding miners and wattlebirds in a stand of threatened, disjunct or depleted habitat. Peak flowering Red Ironbark/Yellow Gum box–ironbark woodland are the only habitats in GM that attain diversity parameters significant at the state or higher level. These stands are benchmarks for nectarfauna conservation in GM.

National: 13 or more species (> 65% of the honeyeater fauna of GM)
State: 9–12 species (45–65% of the honeyeater fauna of GM)
Regional: from 5 to 8 species (25–45% of the honeyeater fauna of GM)

f. Breeding migratory insectivores. Census and area search for breeding or suspected breeding forest/woodland birds in a stand of threatened or depleted habitat. Stands of grassy woodland, gully woodland, or riparian forest habitats supporting this diversity of foliage birds usually have minimal rates of eucalyptus dieback and are benchmarks for fragmentation fauna studies in GM.

State: more than 12 species (> 45% of this fauna of GM)
Regional: from 7 to 11 species (30–45% of this fauna of GM)

g. Breeding parrots. Census and area search in a stand of threatened habitat. River Red Gum grassy woodland/floodplain riparian woodland, Yellow Box–Candlebark grassy woodland and Manna Gum riparian forest are the only habitats in GM that attain diversity parameters significant at the state level. These stands are benchmarks for the conservation of hollow-dependent fauna in GM.

State: more than 8 species (> 45% of the indigenous parrot fauna of GM)
Regional: from 5 to 7 species (30–45% of the indigenous parrot fauna of GM)

h. Bats. Trapping survey of two or more consecutive or concurrent trap-nights. Stands containing diversity parameters significant at the state level are usually dominated by mature trees containing ample hollows. These are benchmarks for the conservation of hollow-dependent fauna in GM.

State: more than 8 species (> 45% of the insectivorous bat fauna of GM)
Regional: from 4 to 7 species (25–40% of the insectivorous bat fauna of GM)

i. Arboreal mammals. Spotlighting/trapping survey.

State: more than 7 species (> 66% of the arboreal mammal fauna of GM)
Regional: from 4 to 6 species (40–66% of the arboreal mammal fauna of GM)

j. Ground mammals. Area search and trapping survey.

State: more than 9 species (> 50% of the ground mammal fauna of GM)
Regional: from 5 to 8 species (30–50% of the ground mammal fauna of GM)

k. Frogs. Evening count and day area search. Wetlands containing diversity parameters significant at the state level are bio-indicators of wetland integrity and benchmarks for amphibian conservation in GM.

State: more than 10 species (> 60% of the amphibian fauna of GM)

Regional: from 6 to 9 species (30–60% of the amphibian fauna of GM)

l. Reptiles. Area search and trapping survey. Threatened grassland and riparian habitats containing diversity parameters significant at the state level are benchmarks for herpetofauna conservation in GM.

State: more than 11 species (> 30% of the reptile fauna of GM)

Regional: from 6 to 10 species (15–30% of the reptilian fauna of GM)

m. Freshwater fish. Electrofishing or netting survey.

State: more than 5 native species (> 15% of the freshwater fauna of Victoria)

Regional: from 2 to 4 native species (10–25% of the freshwater fauna of GM)

n. Other fauna. Assemblages or breeding observations of other faunal groups where data is available.

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

Representativeness is reviewed under criterion D and E (refer to Reference Grid Survey in Survey Methods).

To qualify, a site represents the range, characteristics, variation and ecological amplitude of faunal communities, species or assemblages within a biophysical type. The representativeness of the fauna is assessed on species richness and rarity components. The three faunal diversity classes (regional, state and national; insufficient data were available to assess the latter for many of the sub-criteria) were determined from a hand analysis of field data sheets recorded during the fauna survey of GM. These correspond to the range of the 50–80, 80–95 and >95 percentiles of each sub-criteria across all 2' grids in GM.

A 1' grid supports:

a. All native vertebrate fauna (to be cited national, the site contains one of the most diverse faunal assemblages known within a biophysical type in Victoria)

National: over 200 native species (includes >15 mammal and reptile species)

State: from 150 to 200 native species (includes >10 mammal/reptile species)

Regional: from 70 to 149 species (includes >5 mammal/reptile species)

b. Native birds. Adapted from Lane *et al.* (1984); Schulz *et al.* (1991).

National: more than 150 native species (>38% of the native avifauna of Victoria)

State: from 110 to 149 native species (33–45% of the native avifauna of GM)

Regional: from 50 to 109 native species (15–33% of the native avifauna of GM)

c. Native mammals

State: more than 22 native species (>45% of the mammal fauna of GM)

Regional: from 7 to 21 native species (15–45% of the native mammal fauna of GM)

d. Herpetofauna

State: more than 25 reptile & frog species (>45% of the herpetofauna of Victoria)

Regional: from 9 to 24 reptile & frog species (15–45% of the herpetofauna of GM)

e. Freshwater fish. During the electrofishing survey of NEM and until the recent installation of a fish-way at Dights Falls, there were only nine native species recorded in the Yarra system upstream. There was little chance of any upstream point survey being able to achieve State significance for freshwater fish diversity.

State: more than 6 native species (>15% of the freshwater fauna of Victoria)

Regional: from 3 to 5 native species (15–30% of the freshwater fauna of GM)

f. Butterflies

State: more than 32 species (>25% of the butterfly fauna of Victoria)

Regional: from 15 to 31 species (20–40% of the butterfly fauna of GM)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

A 1' grid supports:

a. GM critical fauna (R1–R4 species). These are regionally significant species whose status in the Greater Melbourne and Port Phillip Catchment is listed as R1, R2, R3 or R4 (see below and Appendix 1). State representativeness parameters indicate that the faunal assemblage is one of the finest examples within its biophysical type in GM.

State: 26 or more species

Regional: 15 to 25 species

b. Regionally endangered fauna (R1 species). Species recorded from 1–9 (<1%) of surveyed 2' grids in GM. For freshwater fish, R1 species include those recorded from 1–5 (<10%) of the electrofish sites in NEM. The majority of these species largely occupy threatened or disjunct habitats and are in danger of regional extinction in GM. These have been eliminated from over 50% of their range in GM or populations are declining and fragmented in over 75% of their remaining range in GM. Excludes vagrants, non-breeding migratory or released native species that are threatened elsewhere in Victoria (e.g. Murray Cod, Murray River Tortoise) which have been listed as R3.

State: 4 or more species

Regional: from 1 to 3 species

c. Regionally vulnerable fauna (R2 species). Species largely occupying threatened or disjunct habitats, recorded from 10–39 (1–5%) of surveyed two minute grids in GM. For freshwater fish, R2 species include those recorded from 6–10 (10–20%) of the electrofish sites in NEM. These species have been eliminated from over 50% of their range in GM or populations are declining and fragmented in over 75% of their remaining range in GM.

State: 6 or more species

Regional: from 1 to 5 species

d. Regionally rare fauna (R3 species). Species largely occupying non-threatened habitats and recorded from 10 to 39 (1–5%) of surveyed 2' grids in GM. For freshwater fish, R3 species include those recorded from 6–10 (10–20%) of the electrofish sites in NEM. These species are often naturally uncommon or localised but are still considered secure in over 50% of their former range. The category also includes vagrant or irruptive migratory species that do not normally breed in GM. It also includes several species which are nominally R1 on apparent distribution and habitat but for various reasons (e.g. difficult to detect/trap, utilising artificial habitats) they are apparently more common or widespread than data indicate or have been less severely affected by land settlement.

State: 8 or more species

Regional: from 1 to 7 species

e. Regionally depleted fauna (R4 species). Species largely occupying threatened or disjunct habitats, recorded from 40 to 79 (5–10%) of surveyed two minute grids in GM. For freshwater fish, R4 species include those recorded from 11 to 20 (20–40%) of the electrofish sites in NEM.

State: 12 or more species

Regional: from 2 to 11 species or breeding populations of one or more

f. Regionally restricted fauna (R5 species). Species largely occupying non-threatened habitats and recorded from 40 to 79 (5–10%) of surveyed two minute grids in GM. For freshwater fish, R5 species include those recorded from 11 to 20 (20–40%) of the electrofish sites in NEM.

Regional: 8 or more species or breeding populations of 4 or more

g. Nesting birds of prey/parrots. The Wedge-tailed Eagle or regionally endangered, vulnerable, rare, depleted or restricted (R1–R5) birds of prey including the Swamp Harrier, Spotted Harrier, Black Kite, Little Eagle, Whistling Kite, Australian Hobby, Peregrine Falcon, Black Falcon, Grey Goshawk, Collared Sparrowhawk, Barking Owl, Powerful Owl, Sooty Owl or Masked Owl. The Yellow-tailed Black-Cockatoo and Gang-gang Cockatoo, Purple-crowned Lorikeet or regionally endangered, rare, depleted or restricted (R1–R5) parrots including the Rainbow Lorikeet, Little Lorikeet, Little Corella, Long-billed Corella, Cockatiel, Australian King-Parrot, Blue-winged Parrot or Budgerigar.

State: 3 or more species

Regional: from 1 to 2 species

F. POPULATION DENSITY: Viability and Abundance—point census

The integrity or viability of a faunal population is assessed on species density and abundance components. Population census or trapping sites were based on Australian Mapping Grid 100 m reference points (see Diversity; Criterion C). Area counts were usually conducted over 5–20 ha. This criterion is most relevant to populations of freshwater fish, sedentary hollow or substrate dependent mammals, reptiles and amphibians and to nesting sites or important feeding areas of colonial or migratory birds. Many of these fauna have narrow ecological amplitudes and their life cycles (or part of) may depend on particular seral or mature stages of vegetation. They are consequently naturally restricted or declining in range. Each of these fauna is prone to elimination through habitat fragmentation, predation or human-induced disturbance.

There is an incomplete state-wide database on faunal density counts and comparative analysis is unavailable. The following density classes were adapted from the regional fauna surveys of GM. Insufficient data were available to access National significance for most of the sub-criteria. A population count from a repeatable, single season, standardised and intensive area/time search, bird census or trapping effort was conducted. A 1' grid supports:

a. International migratory birds. Area count for species including Latham's Snipe protected under international treaties such as JAMBA and CHAMBA; adapted from Lane *et al.* (1984); Schulz *et al.* (1991).

National: from 1000 to 3000 waders (or from 10 000 to 20 000 occupying a larger contiguous area) or 250 to 500 Latham's Snipe or a roosting or feeding aggregation of 5000 to 10 000 other migratory birds

State: from 100 to 1000 waders or 30 to 249 Latham's Snipe or a roosting or feeding aggregation of 500 to 5000 other migratory birds

Regional: from 10 to 99 waders or 3 to 29 Latham's Snipe or a roosting or feeding aggregation of 100 to 499 other migratory birds

b. Rare or threatened fauna. Census/trapping/area count of an endangered, vulnerable (notably flocks of Swift Parrots or schools of Australian Grayling), rare, potentially threatened, insufficiently known or indeterminate species in Australia or Victoria.

National: 5 or more of an Australian endangered species or over 100 of an Australian vulnerable species

State: 5 or more of a Victorian endangered species or 10 to 99 of a vulnerable species or over 100 of a rare, potentially threatened, insufficiently known or indeterminate species

Regional: 5 to 9 of a vulnerable species or 5 to 99 of a rare, potentially threatened, insufficiently known or indeterminate species

c. Waterfowl. Area count including grebes and coot.

State: from 500 to 5000

Regional: from 100 to 500

d. Breeding seabirds. Area count excluding gulls and terns (sub-criterion not applicable to NEM).

National: more than 5000 birds

State: from 500 to 5000 birds

Regional: from 100 to 499

e. Honeyeaters. Census and area count excluding wattlebirds and miners in a stand of threatened or depleted habitat.

National: 1000 or more honeyeaters

State: 300 to 999 honeyeaters or 100 or more lorikeets

Regional: from 50 to 299 honeyeaters or 20 to 99 lorikeets

f. Frogs. Evening count and day area search excluding the Common Froglet and Spotted Marsh Frog at a single wetland or wetland complex.

State: over 50 of four or more species or 300 to 3000 of two species

Regional: over 50 of three species or 100 to 299 of two species

g. Rare/restricted colonial fauna. Area count. A breeding or roosting colony or feeding aggregation of rare or insufficiently known cave-dwelling bats or restricted colonial birds (e.g. Darter and Nankeen Night Heron but excluding seabirds and international migratory waders) or other colonial species (e.g. Cattle Egret, ibis and cormorants but excluding Silver Gulls and passage birds such as needletails).

State: 50 to 2000 cave-dwelling bats or breeding restricted colonial birds or 1000 or more non-breeding restricted colonial birds or other colonial fauna

Regional: 10 to 49 cave-dwelling bats or breeding restricted colonial birds or 100 to 1000 non-breeding restricted colonial birds or other colonial fauna

h. Other fauna. Relating to significant populations of native species not included previously; adapted from Schulz *et al.* (1991). This sub-criterion includes butterflies where data is available.

State: from 5% to 10% of the known Victorian population of a species

Regional: from 1% to 5% of the known Victorian population of a species

i. Bat trapping rate. Trapping survey. Single trap capture or trap-night average (divide the total capture by the number of traps set) of bats. Must be more than four trapped species and if the trapping effort exceeded one night, these were consecutive or concurrent.

State: single capture exceeding 60 bats or trap-night average of > 30 bats

Regional: single capture of 30 to 59 bats or trap-night average of 10 to 29 bats

j. Electrofishing rate. Electrofishing or netting survey of two or more species of native fish.

State: return of more than 500 native fish

Regional: return of 30 to 500 native fish

k. Regionally endangered fauna (R1 species). Census/trapping/area count excluding F^{abg} .

State: 20 or more or highest known population density in GM

Regional: 5–19 animals

l. Regionally vulnerable fauna (R2 species). Census/trapping/area count excluding F^{abg} .

State: 70 or more or highest known population density in GM

Regional: 5–69 animals

m. Regionally rare fauna (R3 species). Census/trapping/area count excluding F^{abg} .

State: 100 or more or highest known population density in GM

Regional: 5–99 animals

n. Regionally depleted fauna (R4 species). Census/trapping/area count excluding F^{abg} .

Regional: 10 or more or a significant population in the context of other survey reports in GM

o. Regionally restricted fauna (R5 species). Census/trapping/area count excluding F^{abg} .

Regional: 20 or more or a significant population in the context of other survey reports in GM

Outlook

The key conservation measures which would improve and the key threatening processes which would diminish the faunal or habitat significance of the site are reviewed.

DELINEATION OF SITE BOUNDARIES

The site boundaries are based on native vegetation cover determined by field survey and the most recent available 1:25 000 series maps and aerial photos. The masters of these maps are lodged with the Shire of Nillumbik. Sites have been mapped at a scale of 1:50 000 for presentation in this report.

Site boundaries reflect the habitat requirements of the faunal assemblages they support. The typically uneven distribution of species within a site is due to a combination of factors such as landform, geology, geomorphology, soil, elevation, rainfall, vegetation and land-use. Site boundaries have been drawn on the basis of high points in faunal diversity, distribution of rare or threatened species, or other features of faunal significance. These are distinguished on the basis of identified critical habitat (e.g. rocky outcrops and presence of intact native flora assemblages) and impact of habitat threatening processes. They have been defined by landmarks such as mountain peaks and bridges. Site boundaries were determined to provide sufficient areas of habitat for the long-term viability of fauna and usually include several habitats (e.g. wetlands and adjacent woodland and grassland).

The breeding and other specific habitat requirements needed to support viable populations of most native faunal species and assemblages remain ill-defined. Little is known on the status and ecology of some species in NEM. For example, the Plains-wanderer inhabits broad-acre tracts of volcanic plains grazing land. It is likely to utilise denser stands of grassland (e.g. during droughts). The required habitat combination is unknown. Site boundaries catering for these species have been drawn to maximise their habitat area.

Precise boundaries were determined after examination of 1:25 000 and 1:50 000 topographic series maps. Geological and land tenure maps and aerial photographs (vegetation) and the following features were taken into consideration.

- *Topography.* Ridgelines, water catchments and other definable physical boundaries.
- *Fragility of habitat.* Habitats sensitive to disturbance require adequate buffer areas to protect the integrity of the faunal species and communities.

- *Proximity to large areas of natural habitat.* These areas provide the capability for replenishment of fauna in smaller areas that may be otherwise unable to sustain a diverse faunal complement.
- *Quality, quantity and connectivity of available habitat.*
- *Natural boundaries of discrete areas of available habitat.* Sites are as homogeneous as possible with respect to landform (e.g. marshland systems), geology, soil, elevation, rainfall and vegetation.
- *Land tenure and land-use.* Site boundaries are frequently public land boundaries and take into account both internal and external land-use.
- *Population estimates derived from bird censusing.* This was used to determine the function of internal and external faunal corridors and habitat links, the viability and degree of fragmentation of habitat patches and the extent of habitat required for the conservation of threatened species.
- *Provision for change in distribution and abundance of species.* Changes in vegetation succession and habitat diversity (particularly under changing land management) occur over time.

Sites larger than a 1' grid include adjacent areas that may contain additional fauna species to those recorded in the selected grid. These are included in the 'overall' diversity of faunal species for the site.

SITE DESCRIPTIONS

One hundred and four sites of faunal and habitat significance have been identified in NEM and descriptions of these are contained in Volumes 2 to 6. There were 6 national, 44 state and 56 regional sites of faunal significance (refer to Introduction and Maps 2 &3).

Terminology and Format

The most significant sites contain extensive or intact and diverse (both floristically and structurally) stands of natural vegetation and threatened habitats and species. Sites yielding high faunal species diversity generally contain an overlap of differing landform, geological, soil and vegetation types.

The 104 sites are presented across 5 biophysical regions and 12 biophysical zones in 40 management units. Zones and management units appear in order of biogeographical relationship within the biophysical regions (see Chapter 3). The biophysical regions are:

- **Volcanic Plains—Lowland and Upland (vol 2)**
- **Alluvial Plains—Lowland and Upland (vol 3)**
- **Hills—Lowland (vol 4)**
- **Hills—Upland (vol 5)**
- **Ranges (vol 6)**

REGION

Name and Code**Site directory**

Habitats. Summary including distribution and quality assessment across the region.

Geological and landform/soil types. Summary including distribution across the region.

MANAGEMENT UNIT

Name and Code

A management unit contains one or more adjacent sites of significance which have physical and biotic features and land-use in common. Related biophysical zones are contained within particular physiographic regions (i.e. alluvial plains, volcanic plains, hills, or ranges). Biophysical zone boundaries generally conform to vegetation, faunal, geological and regional catchment boundaries. Management unit boundaries within biophysical zones generally conform to land-use and landform (e.g. local catchment) boundaries. Management issues for one site effect outcomes in other sites within that unit and are generally applicable throughout the unit. Broad management issues flow across all units within the biophysical zone. The site boundaries are based on intensive faunal and habitat survey and biological analysis. The site boundaries also serve as management boundaries for LandCare or Friends groups. Integration between groups in neighbouring sites within a unit is essential as this larger area contains a homogeneity of land-use patterns, general interests, biological values and management issues.

Map Reference: Name of 1:100 000 map sheet and Australian Mapping Grid Reference (AMG) is supplied. Map references are given for the mid-point of key habitat patches or landmarks within the site. Map references for units based on watercourses and catchments are supplied from the downstream to upstream points, and for railway reserves from the nearest to farthest point from Melbourne.

Location/Size: The unit is generally defined by the boundaries. These are usually ridges, streams, and occasionally roads. The approximate size of the unit is given in hectares.

Municipality: The city(s) or shire(s) in which the unit occurs.

Description: Land-use and general description.

Physical Features

Landforms: The major types (including wetlands) are summarised.

Hydrology: A description of the streams and waterbodies. Waterbody and watercourse categories and sub-categories follow Norman and Corrick (1988). These have been used by Schulz *et al.* (1991) who have described the wetlands of the Coastal and Western Volcanic Plains of Western Melbourne.

Rainfall: The mean annual rainfall range in mm.

SITE NUMBER AND NAME

Map Reference: Name of 1:100 000 map sheet and Australian Mapping Grid Reference (AMG) is supplied. Map references are given for the mid-point of key habitat patches or landmarks within the site. Map references for sites based on watercourses and catchments are supplied from the downstream to upstream points, and for railway reserves from the nearest to farthest point from Melbourne. The 1' latitude by 1' longitude grids which occur internally and exclusively to the site are listed. Grids along mutual boundaries of sites were nominated to only one of the sites to avoid data repetition in the printouts.

Location/Size: Where appropriate, the distance from a prominent and named feature on the map sheet is provided. The approximate size of the site is given in hectares.

Municipality: The city(s) or shire(s) in which the site occurs.

Land Tenure/Use: Whether private or public land. For the purposes of the present survey, public land includes land owned or leased by the Commonwealth, state and local governments. For public land a listing of the controlling management agencies is provided; authorities and instrumentalities such as Vic Roads, V Line and Melbourne Water are only listed where they own/manage significant habitat (e.g. road, rail and aqueduct reserves). A brief description is given of the type of land-use.

Landforms: The major types (including wetlands) are listed.

Natural Heritage Value

Landscape. This is not discussed for every site, only where it is known and believed to be the most, or one of the most significant of its type in a regional or higher context.

Scientific and Educational Values

This is not discussed for every site, only where it is known and believed to be significant in a regional or higher context.

Invertebrates. This is only presented as anecdotal information on personal observations and some personal communications. It should not be used for comparative purposes as the literature on the subject has not been reviewed. Invertebrate survey is strongly recommended.

TYPE locality. A TYPE locality of a plant or animal species or subspecies.

Scientific reference. It contains a scientific reference point (e.g. census plot or electrofishing site) or a study site of a faunal species or assemblage contributing to a wider understanding of natural history, conservation, scientific or ecological knowledge (e.g. forms a key population and study site of a rare or threatened species in Victoria, etc.).

Habitat Significance

Assessment of the site's significance and category (conservation status) and a list of any reference or relatively intact stands of particular vegetation communities, keyed to the description at the beginning of each volume (physiographic region). Features of critical assemblages or populations (e.g. Strategic Habitat Links, Ecological Reference Areas) are discussed.

Faunal Significance

For ease of reference this information has been summarised in a boxed key for each site. Links between these keys and more detailed information allow the reader to move easily from one to the other. The significance rating (e.g. National, State and Regional) and Category (e.g. 1, 2, and 3) were assigned following the criteria discussed in Chapter 7 and summarised in Appendix 1.5.

The criteria for selection of significance is noted in italic letters preceding the listing.

The key to the selection criteria is presented. A summary of the rarity, abundance and diversity of species and assemblages within each surveyed group of native vertebrate species (and butterflies) is presented in the key.

Fauna

Faunal descriptions for the site. Relevant annotations of key species or assemblages are given for each site. Detailed descriptions usually only appear once for a particular species in the report. Where a species is listed for a site, but not annotated, the reader should refer to other broadly similar sites where it occurs and has been discussed (usually cross-referenced).

Management

Threatening Processes. A description of major human modifications and an account of the extent (if substantial) of the main activities and influences that have caused a decline in the fauna and faunal habitat values of the site. Widespread threatening processes are described in this volume and links are provided from their listing under particular sites. This section also includes comments on developments within or adjacent to the site that may have an important influence on faunal values. Where relevant these are linked to more detailed descriptions under other sites within the management unit and biophysical zone and to discussions under the Regional Conservation Strategies of Volume 1.

Conservation Measures. These are aimed at maintaining and ultimately improving genetic diversity, ecological processes and specific and essential habitat. Suggested management guidelines that would maintain or raise fauna and faunal habitat values of the site are provided, but are by no means exhaustive at the site level. For further information the reader should refer to other sites occurring within the management unit and biophysical zone and to discussions under the Regional Conservation Strategies of Volume 1.

Planning Recommendations. These are provided only for sites with special requirements, such as those forming part of a recommended Ecological Reference Area (see Chapter 9).

CHAPTER 8

WIDESPREAD THREATENING PROCESSES

DIEBACK

Many factors can apparently lead to eucalyptus dieback. Most arise from land management practices that cause increased levels of stress to native vegetation. They include soil pathogens spread by earthworks, alteration of soil drainage patterns, intensive livestock grazing (nutrient enrichment and soil compaction), land cultivation and cropping and habitat loss and fragmentation of bushland by clearing. The latter is considered the most critical. Foliage loss caused by native insect species is the most frequent cause of rural tree-dieback in Australia. Tree species in NEM most affected include River Red Gum, Swamp Gum, Yellow Box, Narrow-leaf Peppermint and Red Ironbark.

Tree decline and dieback caused by insect defoliation has been found to be directly caused by declining populations of foliage birds. When the foraging and breeding habitat of these birds becomes critically limited by tree clearing, foliage insects under favourable climatic conditions are able to build up populations to epidemic proportions which greatly exceed food supplies. As dieback proceeds, conditions are provided promoting the insects and discouraging the foliage birds that regulate their populations. The level of foliage insect predation is diminished. The insects multiply and consume more leaves and dieback proceeds in an accelerating spiral known as a positive feedback condition. Without adequate protective habitat management and restoration this may culminate in heavy tree mortalities.

The dieback cycle in narrow habitat links or fragmented and thinned stands is enhanced by Noisy Miners or Bell Miners. Both native miner species have increased in numbers and expanded in range in response to the fragmentation of forest habitat caused by clearing, livestock grazing, fires and land subdivision. Concomitant with this increase has been a decline in foliage canopy insectivores (e.g. pardalotes) and an increase in rates of leaf damage. Both species of miners competitively exclude these birds and contribute to eucalyptus dieback. Miners exploit fragmentation as they can more successfully maintain territories when surrounded by open space. They keep other foliage insectivores out by aggressive territorial defence and alone fail to control psyllids and other foliage insects.

Land settlement and River Red Gum dieback

(See also Appendix 2.2)

Areas of River Red Gum grassy woodland in southern Victoria form prime sheep and cattle grazing land. These woodlands once extended from Yan Yean to south of Dandenong and characterised much of Melbourne's early natural and pastoral environment. Much of this area has been cleared or severely modified by urban development. Remnant stands of mature River Red Gum on farmland at the northern periphery of Melbourne and in the outer northern suburbs are now undergoing chronic and continual leaf defoliation and dieback. This is most prevalent and severe where land-use practices have been most intense.

Long-term stress from the effects of modified land-uses has caused severe loss in the vigour of remnant stands. Stress-inducing processes include tree clearing; draining and damming of wetlands (altering the hydrological cycle and water table); grazing by livestock, rabbits and hares (causing loss of seedling regeneration, soil compaction and phosphate enrichment); land cultivation and cropping; and the application of fertilisers, insecticides and herbicides. These have led to severe environmental degradation such as water pollution, soil salination, weed invasion and leaf defoliation. These processes each contribute to progressive branch-tip and tree-crown dieback and ultimately, the death of trees (Podger 1981). Weed invasion has displaced understorey species and associated host-specific invertebrate fauna (Vaughan 1988). Restoration and

replanting of River Red Gum habitats in rural parts of North East Melbourne need to become a high priority of the Greening Australia and LandCare projects.

Stands of River Red Gum in the Plenty Lowland Volcanic Plains (see Volume 2) were in an area proposed for urban development in the 'Plenty Growth Corridor' (MPE 1989). Proposed subdivision had the capacity to eliminate stands, reduce the density of trees and increase the level of disturbance to wildlife. Already many stands composed of senescing trees in 'pastured' paddocks where the density of River Red Gums had been reduced were in obvious ill-health and premature decline (e.g. from insect damage). Some of these stands contained 'scar trees' made by Aborigines before contact with European settlement. The age of the mature trees was well in excess of 200 years and often exceeded 500 years. Little re-establishment of River Red Gums or other native tree and shrub species has taken place during the 150 years of rural settlement in the district.

The role of leaf insects in the dieback cycle

The high rate of leaf damage in River Red Gums on treed farmland was caused primarily by the larvae of psyllids (sap-suckers) and Gum-leaf Skeletonisers (leaf eaters). Populations of these are promoted during periods of high environmental stress or climatic extremes. In dry, hot summer weather at the end of the spring foliage growth spurt, photosynthesis mobilises sugars in the phloem tissue and starch accumulates in the roots. At this time, leaf damage from psyllids (sap-suckers) becomes apparent. Psyllid activity starts as early as October in dry years.

Heavy late summer rains cause a second foliage growth spurt. A dry, warm period following in early autumn provides optimal conditions for psyllid growth and reproduction, enabling a high proportion of second generation nymphs to develop to maturity. At this time many of the important migratory foliage birds which partially control the early summer outbreak are not present. The ensuing psyllid outbreak is usually more severe and extensive leaf damage and protein breakdown occurs. This releases more nitrogen into the phloem tissue which then becomes available to the sap-suckers. As psyllid nymphs feed and grow the leaf tissue around them discolours and leaf senescence and fall accelerates. Intense summer droughts and the conditions prevailing in urban areas and on farmland, place trees under constant stress. Trees under these conditions have a relatively high rate of soluble nitrogen which favours the sap-suckers (White 1971, Morgan & Bungey 1981). During psyllid outbreaks, trees turn from green to red to brown in a matter of weeks as if a fire had swept through their crowns (White 1971).

If insects severely defoliate a tree there is inadequate leaf area remaining for photosynthesis and food production (Heatwole & Lowman 1988). After several cycles of defoliation, reserves of stored food (starch) in the roots run down and the tree is less able to produce new leaves and roots. Severe crown dieback occurs and trees may die. During dry summers, which are optimal for psyllids, the loss of water due to the sap-suckers, in combination with long-term loss of root production, causes severe water stress. In droughts the trees die. The frequency of cycles appears to be shortening and insect outbreaks and severe leaf damage are occurring in about two years out of every three. In some urban areas, such as near the Plenty River bridge at Lower Plenty, trees are being continually attacked and the entire stand is in poor health.

Psyllid and Gum-leaf Skeletoniser populations and those of many other leaf defoliating insects fluctuate seasonally and usually operate sequentially (Morgan & Bungey 1981). Cycles of severe mature leaf defoliation by psyllids are followed by intervening periods of partial new foliage recovery. Damage to this foliage by adult Christmas beetles and larvae/adult chrysomelid beetles also peaks during late spring and summer. The Christmas beetles, whose larvae feed on grass roots, have benefited from the increased amount of food resulting from the conversion of the native grasslands to alien pastures (Heatwole & Lowman 1988). The adults are then able to concentrate on the reduced number of eucalypts left after clearing. Application of fertilisers and increased livestock grazing density causes soil enrichment and compaction, which may change the soil moisture regime. This creates conditions of stress on the trees which favour the insect defoliators.

Gum-leaf Skeletoniser outbreaks occur in wet years (i.e. during foliage growth spurts and favourable climatic conditions for reproductive activity of the moth). The most severe damage caused by skeletonisers occurs in late winter–spring. The larvae favour new foliage on stressed trees previously attacked by psyllids.

In optimal years when spring and late summer rains enable two growth spurts in the River Red Gums, the skeletonisers have two outbreaks, building up population levels to epidemic proportions. Skeletonisers are particularly prevalent in the mid and lower tree strata. The absence of adequate shrub layers (and shrub layer birds) in stands of River Red Gum make the highly palatable leaves of saplings prone to skeletoniser attack.

There is a possible link between changing climatic conditions under 'greenhouse' and the escalating rates of eucalyptus dieback occurring throughout south-eastern Australia (Henry Nix pers. comm.).

Relationship of cover loss and habitat modification with dieback

Census studies of insectivorous birds in the River Red Gum woodlands found that there was a direct relationship between the extent of cover loss and modification of the original vegetation with the severity of dieback (Beardsell 1989; chapter 5).

It was found that stand thinning and fragmentation had decreased or locally eliminated populations of many beneficial insectivorous forest-dependent birds such as the Spotted Pardalote and had increased populations of species harmful to tree health such as the Noisy Miner. As tree density or stand area is reduced by clearing, the diversity of beneficial forest-dependent foliage birds decreases and the rates of leaf defoliation and tree crown dieback increase. In stands severely affected by leaf defoliation, forest foliage insectivores were virtually absent. In treed farmlands, any regulating influence that foliage birds may have over the abundance of insect leaf defoliators is lost.

Loss of shrub layer increases the rate of eucalyptus leaf damage

Lower rates of sapling defoliation were observed in roadside sections amongst woodland containing a native grassland understorey. Elimination or depletion of the native understorey habitat (i.e. shrubs, herbs and eucalypt saplings) has also led to a progressive decline in richness and density of beneficial insectivorous shrub layer birds.

Dominance of aggressive native and alien birds with urban growth

Linear habitat links or fragmented and thinned stands are largely occupied by open space and forest edge inhabiting species (e.g. Noisy Miners). Disturbance and loss of habitat from urban growth and inadequate management of remnant bushland can decrease the total area of stands and increase the degree of internal fragmentation. This renders a disproportionately high 'edge' to 'interior' habitat area ratio which lowers biological values and raises the level of management requirement. Habitat patches adjacent to areas dominated by human activity are subjected to high levels of disturbance (Taylor 1987). This produces a situation where the whole patch is perpetually disturbed and so becomes, in effect, entirely like an 'edge' in its pattern of disturbance. Faunal assemblages in disturbed 'edges' are not ecologically equivalent to those found in natural successions within 'interior' vegetation. Perpetual disturbance prevents faunal succession beyond early, colonising stages and favours aggressive alien 'open space' species such as the Common Myna and Common Starling.

LOGGING

Loss of hollow dependent species

Old-growth forest is dominated by trees which have reached maximum vertical and horizontal expansion and provide large, hollow-dependent arboreal fauna such as the Greater Glider (important prey of the Sooty Owl). Clearfelling of 20–40 ha coupes on cutting-cycle rotations of less than 80 years can locally eliminate them. This impact is unlikely to be mitigated by environmental prescriptions placed on logging such as stream retention strips of old-growth forest or the retention of stag trees in coupes. In practice, some of these prescriptions are not followed. Stream retention strips are usually incinerated by post-harvesting operations or may collapse on exposure to wind (Smith & Lindemayer 1988).

The hydrological cycle and logging

Logging of mountain catchment forests affects the water quality and hydrological cycle. Initially there is increased turbidity and sedimentation caused by rapid runoff from the logging areas. As the forests regenerate through early and middle successions (upwards of 80 years) the water is used up by tree growth and its entry into streams declines. Rotational harvesting causes permanent reductions in stream flows. In many cases the combined effects of these processes have changed second and third order streams from perennial to intermittent. This has restricted the breeding and feeding opportunities of native fish.

FRESHWATER WETLAND HABITAT LOSS AND DEGRADATION

Over half the original extent of wetland habitat in Victoria has been permanently lost through reclamation for agriculture and other developments. A significant proportion of the remainder has been altered to such a degree that it is no longer suitable for at least some species of waterbirds (Cowling 1973). From a study of wetlands between Port Phillip Bay and Mt Emu Creek in the Western Volcanic Plains (Corrick 1982) it was found that, since European settlement, 34% of the original area of freshwater wetland has been lost. Shallow freshwater marshes have been the most affected wetland type with 79% being eliminated (of which probably 50% occurred in offstream sections of floodplains), followed by deep freshwater marshes (66%). Much of the remaining freshwater marsh and almost all of the freshwater meadow habitat has been substantially modified or degraded. Only 1% of freshwater meadows and 5% of shallow freshwater marshes were found to be contained in biological reserves.

STREAM DEGRADATION

(See also Chapter 10 Regional Hydrological Strategy)

Pollution and poor water quality

Water pollution is defined as a significant and deleterious change in the natural character of water resulting from the addition of material or heat by humans (Cadwallader & Backhouse 1983). The main documented causes of stream pollution are toxic effluent from urban wastewater runoff and sewage and industrial discharge. Surface and ground water has been polluted by industrial toxins including heavy metals, polychlorinated biphenyls, hydrocarbons and radioactive wastes. These are dumped or indirectly seep (from storage tanks and tips) into waterways. The phosphates and nitrates associated with sewage effluent and urban wastewater, in combination with industrial discharges, are causing loss of biological diversity in marine ecosystems. Since all things interconnect, this is having severe ramifications in the commercial fisheries. A further contributing factor of unknown and diffused magnitude, but with potentially greater level of conflict, arises from poor farm management practices. These have led to stream siltation, water turbidity and salinity and excessive accumulations of nutrients such as nitrates, phosphates and fertilisers and toxins such as herbicides and pesticides. The increase in water turbidity in streams through land-use induced erosion is estimated to be five times the level produced by natural erosion in streams prior to land settlement. This has turned formerly productive clear water streams into turbid drains lacking in essential life support systems. These processes each lower the water quality and the capability of effective aquatic ecosystem function and raise the level of stress encountered by species.

The availability of water and fertile soils along streams sustains small farms with high livestock rates and intensive agricultural production such as orchards (e.g. along Arthurs Creek). High levels of phosphorous and nitrogen enter the streams from the paddocks. In settled areas streams are subjected to high recreational use and disturbance. Streams, quarries, gullies and mine shafts have traditionally been dumping grounds for rubbish and domestic and industrial effluent. Heavy nutrient loads in combination with loss of summer water flow due to damming and irrigation and high temperatures, cause static pools in the mid-reaches of the Plenty River at Yan Yean and above Whittlesea to undergo eutrophication (high nutrient/low oxygen conditions—see below).

Creek improvement schemes—flood mitigation and flow regulation

These are physical modifications of streams which hasten stream bed and bank erosion, often enhanced by rabbit or livestock activity. There have been flood mitigation works in the urban reaches of most streams, particularly Diamond Creek. In the lower Diamond Creek in the townships of Eltham and Diamond Creek and along the Plenty River at Whittlesea these works have involved de-snagging, and clearing away riparian vegetation (both native species such as Woolly Tea-tree and alien species such as willows) and logs. Retarding basins and weirs have been developed along several streams, including the Yarra.

Removing substrate debris equates directly to loss of Freshwater Blackfish breeding habitat and cover, while removing riparian vegetation equates to loss of feeding and high water breeding habitat for galaxias. This vegetation is necessary for bank stabilisation and clear water. Standing trees likely to fall into streams are also removed. These form potential habitat for blackfish as well as current habitat for hollow-using birds, bats and arboreal mammals. Where streams were straightened to facilitate flow (e.g. Diamond Creek at Chute Street) the stream with alternating pools and riffles meandering through a broad floodplain has been converted into a straight ditch with continuous runs and high levee banks. Low-lying swampland on the floodplain to either side has been filled and reclaimed for playing fields. This has removed essential habitat utilised as breeding areas by instream species such as galaxias and contributed to their elimination.

The need for these projects has arisen from increased demand for agricultural and town water, changing land-uses in catchments, such as tree clearing and heavy grazing, and pressure for increased development of low-lying urban streamways. Loss of water quality, stream flow or flood frequency can be equated to loss of wetland habitat. These projects have had a major impact on the physical characteristics and natural biological diversity of streams.

Altered flow cycles due to tree clearing

Tree removal and understorey vegetation cover loss resulting from agricultural practices have severely altered the differential between the maximum winter and minimum summer flows (i.e. flow cycle). The more gradual runoff of the natural system after rainfall now becomes a flash event and water penetration of the soil profile decreases substantially (see salinity section). Farmland catchments of streams once contained peat bogs and fern glades in their broad sheltered valleys. These perennially seeped into feeder creeks of the streams. Clearing of these forests, plus loss of the native understorey and damage to the substrate caused by livestock, has eliminated the water seepage which fed streams between rainfall events.

Eutrophication

Eutrophication occurs over summer as the water and dissolved oxygen levels drop and water temperature rises. This is caused by the combined effects of siltation and nutrient input and loss of water flow. Advanced stages have developed in urban areas (e.g. Bailey Billabong, East Ivanhoe). Dissolved oxygen is critical to maintaining instream ecosystems, particularly aerobic bacteria which are vital for the breakdown of pollutants. Insufficient levels lead to anaerobic decomposition of organic material, production of noxious gases such as hydrogen sulphide and methane and chemical reduction of iron and manganese. Aerobic conditions enable the oxidation of heavy metals to oxides which are absorbed in a natural process into the substrate. Anaerobic conditions stimulate the growth of algae. Severe outbreaks or 'blooms' may kill animal life by further de-oxygenating the water or by direct poisoning (e.g. *Anacystis*). The Short-finned Eel and species of introduced fish (e.g. Roach, Mosquito Fish and Goldfish) which have adapted to these conditions, predominate (McKenzie & O'Connor 1989).

Streamway disturbance and loss of riparian vegetation

Stream bank vegetation acts as an important buffer from offstream effects such as pollutant, sediment and nutrient runoff and climatic exposure due to loss of shading and disturbance. Loss of native fringing vegetation along streams due to human and grazing animal activities is a key factor in the decline of stream ecosystems. This has caused erosion and turbidity levels to increase and the aquatic flora and fauna, particularly fish, frogs and waterbirds, to alter in composition and decrease in abundance.

Siltation

Since European settlement, soil erosion and stream siltation have greatly increased as a result of land clearing, heavy grazing and altered runoff and drainage patterns. The eroded topsoil from elevated areas is deposited in low-lying flats, depressions and drainage lines. Narrow streams such as Arthurs Creek, which formerly contained clear running water and deep holes have become wide, shallow, muddy tracts with intermittent flows. Tributaries such as Stewart Ponds Creek have become muddy waterholes with heavily eroded banks. Excessive levels of silt destroy fish habitat. Fish such as the Southern Pigmy Perch, which lay eggs on the substrate, have been most affected by increased siltation (Cadwallader & Backhouse 1983).

The blanketing of silt also restricts breeding opportunities for cavity egg-laying fish (e.g. Freshwater Blackfish and Australian Grayling). It fills in the deep holes and blankets the substrate, reducing invertebrate prey diversity, particularly the activity of detritus feeders which recycle the nutrients back into the food chain. Excessive levels of silt restrict the growth of submerged plants by screening the light and inhibit the foraging ability of fish which hunt by sight (e.g. galaxias).

CLEARING AND GRAZING

Soil erosion was found to be most severe in the Plenty Upland Hills. Salinity is also an increasing problem in these areas.

Vegetation loss—increased and more rapid runoff from the bare hills

With loss of vegetation, runoff becomes a flash event of such high volume and velocity that it impacts heavily on the gullies and creeks. Studies conducted at the Parwan hydrological research station (LCC 1985) in the Western Region of Melbourne show that sites with a southerly aspect yield denser, more vigorous vegetation and suffer less soil erosion and runoff. Runoff from grassland was found to be greater than improved pasture and much greater than woodland. Less water reaches the soil surface in woodlands as the tree canopy has high rainfall interception and evapo-transpiration rates. Bare soil or low grasses have lower interception and evapo-transpiration rates. Turbidity readings of water samples taken after a rainstorm breaking prolonged drought indicated that woodland provides a far greater degree of soil protection and that land with a northerly aspect is more vulnerable to erosion.

Soil erosion

An ideal scenario for enhanced soil erosion and salinity problems is provided by poor land management and conservation practices. The dispersible clay subsoils of the steep foothill yellow duplex gullies and hill-slopes are a high erosion hazard. Tunnelling and gullying has been aggravated by rabbit activity. Excessive land clearing and trampling and removal of plant cover (particularly deep-rooted native perennial grasses) by livestock has caused sheet erosion on the shallow stony gradational soil hill-crests.

Sheet erosion

Climatic effects make Australian soils, on world comparison, highly prone to erosion. Excessive land clearing, trampling and denudation of plant cover (particularly deep-rooted native perennial grasses) by livestock (and rabbits) has caused sheet erosion to occur on the shallow stony gradational soil hill-crests and steep hill-slopes. Clearing deep rooted forests and replacing them with shallow rooted annual pastures and crops has led to sheet erosion of the hills. The tree canopy acts like an umbrella. Much of the intercepted rainwater evaporates directly from the leaves. Rain that does reach the forest floor is absorbed by the roots and recycled to the air through transpiration, or runs into seasonal swamps.

Exposure to wind and sun of the deep rooted native perennial grasses causes increased water loss from evaporation during summer. The deep roots of perennials such as Kangaroo Grass help store the water in the subsoil during the dry part of the year. Grazing replaces these by shallow rooted annual species which die off during summer, eventually leaving bare ground in extreme cases. Skeletal soils under heavy grazing pressure can also develop severe infestations of pastoral weeds such as Serrated Tussock. Livestock trampling and exposure to wind and rain develops a hard setting soil and causes an increased rate and velocity of runoff. Grazing depletes the level of soil formation and sheet erosion occurs.

Gully, tunnel and bank erosion

Clearing of foothill forests and excessive grazing of the field layer cover on the dispersible clay duplex subsoils of the steep hills (e.g. Eden Hills) has led to a high erosion hazard, particularly tunnelling and gullying. This is attributable to the increased volume and velocity of runoff from the hills. In the valleys the duplex clay soils swell during heavy rain and block drainage. This and the hard surface causes an increased rate and velocity of runoff. This erosion has been aggravated by rabbit activity. Stream bank erosion such as slumping and undercutting, caused by poor farming practices (e.g. allowing stock direct access to streams) has led to changes in the character of streams (Cadwallader & Backhouse 1983). 'Maintenance of good vegetation cover of pasture species, or of bushland where it is uneconomical or undesirable to establish pasture, is essential to slow down the erosion process' (Jeffery 1981).

Salination

The above processes can lead to salinity problems (see, for instance, Stewart Ponds Creek site). The loss of tree, shrub and grass cover decreases the area of interception of rainwater and the rate of percolation into the subsoil.

Trees pump up the groundwater, causing the clay subsoils to dehydrate and shrink and the watertable to drop, while the subsoil cracks enable vertical drainage of surplus rainfall. The self regulating system breaks down if tree and shrub cover is removed. The uptake of groundwater decreases and the rate of percolation into the subsoil is impaired. This raises the watertable, which can lead to land salination. The most pronounced salinity problems in Victoria are largely in areas such as the volcanic plains. These have low rainfall and high evaporation rates and have undergone extensive land clearing and drainage pattern alteration (LCC 1985). In the western volcanic plains, naturally occurring primary salting originates from surface weathering of basalt rocks, groundwater flows along sub-surface aquifers in basalt fracture lines, percolations through marine sedimentary bedrock and cyclic dumping from the sea onto the land by wind and rain.

In North East Melbourne, secondary salting has been observed in drylands and wetlands on the Merri Volcanic Plains and near Arthurs Creek and at Eden Hills in the Plenty Upland Hills. Secondary salting is the accumulation of soluble salts in the watertable in low-lying areas and is a consequence of human activities in

elevated recharge areas. As the condition advances trees undergo severe dieback and decline and farmland is rendered less productive.

Stream salination

The Merri Creek and some waterbodies on the Merri Plains fed from groundwater appear to be becoming more saline. In combination with over-grazing, which is preventing adequate regeneration and promoting saline surface water runoff, the effect is causing fringing vegetation such as River Red Gums to die and freshwater meadow species to be replaced by salt-tolerant halophytes and Sharp Rush. Little salinity research has been conducted in North East Melbourne.

Relevant studies have been conducted in the Werribee and Little River systems of Western Melbourne (LCC 1985, Lewis 1987). Dryland salting in the form of salt pans occurs along some of the tributaries of the Little River. These develop when salt builds up to levels which are too high for most plants except highly salt-tolerant species to survive. The resultant effect has been widespread decline and death of River Red Gums along downstream sections of the river (Schulz *et al.* 1991). Rosengren (1986) wrote on salting of one of these feeders that 'it appears to be a result of a rise in a saline body of groundwater residing in a basalt aquifer; this rise occasioned by a reduction in the transpiration rate due to extensive clearing of tree vegetation in the groundwater catchment that feeds the stream'.

Where the native vegetation has been cleared, any water that seeps into the soil escapes down the soil profile. It picks up salt from the marine bedrock before being discharged as saline groundwater in low-lying areas along creeklines. The end result of these processes is erosion, aridification and salting of the landscape, and weed invasion.

Dryland salting can result from salt picked up from the eroding rock strata, that is subsequently dumped along valleys, drainage lines and low-lying flats. Ploughing grasslands and pastures during autumn before heavy winter rain (as is the usual practice) also leads to increased salt concentrations in the groundwater. This is due to the temporary loss or simplification of surface plant cover and root zone.

Large-scale clearing of bush, with subsequent establishment of shallow-rooted or annual pasture species, is causing a much greater proportion of the infiltrating rainwater to escape below the root zone than before. This increased seasonal seepage flows towards low-lying areas, picking up salt on the way. It not only increases the salt concentration of the groundwater but causes this now salty groundwater to rise to the surface in the depressions (Jeffery 1981).

Preconditions for the invasion of Chilean Needle-grass

Chilean Needle-grass is advancing over the low-lying grey and black soil grasslands of the Merri Plains. Areas of infestation have a usual scenario: earthworks such as surface rock stripping, absentee ownership, little attention given to land protection and sustainable land-use and a combination of prolonged periods of intense grazing by cattle or sheep, soil compaction and nutrient enrichment. During periods of intense grazing the ground has been bared and compacted and the topsoil has been removed by the action of wind and water. The animal faeces provide an environment rich in phosphates and nitrates. These in combination provide conditions conducive to the spread of the less palatable needle-grass.

Rock stripping, supering, sowing to pasture grasses and clovers and livestock grazing have eliminated deep rooted native perennials such as Kangaroo Grass which compete with the needle-grass. Rocks afford protection from livestock grazing for the native species. If grazing pressure is removed after the needle-grass has established, it stools from runners, seeds heavily and spreads profusely.

The needle-grass was brought into Australia from South America in unquarantined fodder and has spread by the movement of fodder and animals throughout the district. The species is unpalatable (and indeed harmful) to livestock including sheep unless little other food alternative is available. Native species are selectively grazed out. Once this scenario is achieved, the weed advances if grazing pressure is removed. This renders paddocks virtually worthless for livestock productivity and native species significance.

Red Ironbark depletion

In central Victoria most of the lowland box/ironbark and woodland has been fragmented, degraded or cleared by mining and agriculture or been heavily utilised for hardwood production (Porter 1978). Most stands of Red Ironbark and Yellow Gum on public land are now small and composed predominantly of regrowth with few healthy, mature trees remaining. Isolated mature trees on farmland have undergone substantial decline due to stress and insect damage related problems. The long-term viability of most stands of Red Ironbark is under threat. (see chapter 5 for a detailed discussion).

PET OWNERSHIP ISSUES

Those addressed under the Companion Animals Act (see Chapter 9 Conservation Measures) include: the need to confine cats and dogs to owner properties at all times (unless on a leash) and most particularly at night; the establishment of reasonable limits to the numbers of household pets that can be kept; stricter regulations in areas of high potential for conflict between cats and wildlife; the registration of domestic cats and their compulsory provision with adequate identification (as is required for dogs); the credentialled desexing of non-pedigreed domestic cats and dogs; and the implementation of heavy fines on the dumping of unwanted cats in bushland.

Effects of cats on native wildlife

The native predators have primitive skills in comparison to cats and many prey species (e.g. ringtails) display an evolutionary 'naivety' to the hunting and stalking skills, speed, agility, acute senses and weaponry of cats. The animals most hunted by cats are small ground and arboreal mammals and shrub layer birds, particularly wrens and honeyeaters. Many mammal species are unable to coexist with the levels of cat populations present in many areas. Species such as the Long-nosed Bandicoot, whose population has been depleted by habitat loss and fragmentation, are at high risk.

Cats prey on members of all vertebrate animal groups, but most particularly small ground fauna species, which form the bulk of Victoria's endangered and vulnerable fauna. This implicates the predation effect of cats as a significant extinction process acting upon Victoria's most threatened species. About 10% of Victoria's native fauna species have been documented as being predated upon by cats (Seebeck *et al.* 1991). Information on the subject is scant and the actual figure is possibly as high as 25% of all fauna and 50% of the mammal fauna (excluding marine cetaceans, humans and large commensal animals). Noting that cats on certain offshore islands of Bass Strait have devastated nesting populations of marine birds as large as the Little Penguin and the Short-tailed Shearwater (Mutton-bird), few (if any) small and medium-sized animals would be considered at little risk to cats. Even large species are at some risk while giving birth or when young. A compounding problem is the fact that feral populations of cats are continually recruited from dumped or stray domestic animals.

Australian household cat survey

The responses of 3000 residents regarding animals killed by pet cats were summarised in the Bird Observer in 1990 by Dr David Paton, zoologist at the University of Adelaide. It was learned that one in three Australian households keep at least one cat. On average each pet cat brings home five birds, 16 mammals and five reptiles per year. In bushland areas, nearly half the prey were native mammals. The survey sampled a population of presumably well cared for and well fed cats. Despite this, domestic cats were found to take a diverse array of vertebrate prey. The prey numbers of feral and stray cats would be significantly higher. The general consensus amongst respondents was that until their attention was captured by the survey, they were unaware that their cat preyed on so many native animals. It was also found that the presence of bells made little difference to the predating success of cats over wildlife. More than half of domestic cats with bells took birds and mammals and over 30% took reptiles.

Diseases introduced into wildlife populations by cats

Debilitated animals, particularly Common Wombats but also a wide range of mammal species including possums, suffering from behavioural and physical disorders similar to the reported effects of diseases such as Toxoplasmosis and Sarcosporidiosis, have been observed. These diseases are known to be transmitted by cats. Outbreaks in association with habitat loss, the predation effect of cats and disturbance from humans, have the potential to wipe out several species of native mammals. The consequence of the impact of human settlement and associated stress encountered by wildlife is an increase in the susceptibility of these species to disease.

There are nearly 1.5 million cats in Victoria and the numbers are increasing. One-third of these are regarded as feral or stray domestic cats. Cats eliminate wildlife populations by predation, diseases and competition. These combined with habitat loss and failing natural ecosystems are the main causes of declining ground fauna species such as bandicoots. Bites from cats lead to bacterial infections which are invariably fatal to wildlife, unless immediately treated.

Copies of the pamphlet *Protect Your Cat-Protect Your Wildlife* are available from the Department of Natural Resources and Environment Information Centre (9412 4795).

PEST PLANTS AND ANIMALS

Environmental weeds

These are species which invade and reproduce in natural bushland to the detriment of indigenous species. Many are associated with waterways. Woody weeds include Ivy, Japanese Honeysuckle, Blue Periwinkle, Hawthorn, Cherry-plum, Blackberry, White Crack Willow and Madeira Winter-cherry. Herbaceous weeds include Bulbil Watsonia, Three-cornered Garlic, Spear Thistle, Wandering Jew, Soursob, Creeping Buttercup and Purple-top Verbena. Weeds of the sedimentary escarpments and cliffs include Bridal Creeper, alien grasses (see below), Boneseed, St John's Wort, Montpellier Broom and Cleavers.

Alien grasses are a threat to orchids in the foothills. These grasses include Sweet Vernal-grass, Large Quaking-grass, Panic Veldt Grass and Annual Veldt Grass. Woody weeds of hill-slopes include Monterey Pine, Boneseed, Spanish Heath, Montpellier Broom and Cootamundra Wattle, while Blackberry, Hawthorn and Sweet Pittosporum are a threat in gullies. Herbaceous weeds of wetlands of the alluvial plains and foothills include Drain Flat-sedge, Jointed Rush, Cocksfoot, Brown-top Bent, Yorkshire Fog, Paspalum, Water Couch, Kikuyu, Toowoomba Canary-grass, Great Reedmace, Aster-weed, Water Starwort and Pennyroyal.

The fertile soils of the volcanic plains support a wide range of pastoral weeds. The most threatening species of waterways and wetlands include Sharp Rush, Sweet Vernal-grass, Toowoomba Canary-grass, Chilean Needle-grass, Ox-tongue, White Clover and Strawberry Clover. Environmental weeds of stony knolls and escarpments include Common Onion-grass, Serrated Tussock, Fennel, Spanish Artichoke, Patterson's Curse, Montpellier Broom, Gorse, Hawthorn, Sweet Briar and African Box-thorn.

Pest animals

Species restricted largely to urban environments are not included. Those listed have substantial detrimental impact on significant natural vegetation or native fauna populations. Alien species of widespread occurrence and consequence are classified as vermin. These include the Blackbird, Common Myna, Common Starling, Black Rat, European Rabbit, Brown Hare, Red Fox, Feral Cat, Honey Bee and European Wasp. Other species are problems in certain areas (e.g. feral pig and goat in the ranges). Vermin fish of waterways and wetlands include Brown Trout, European Carp, Goldfish, Roach and Mosquito Fish. There are several indigenous or released native species with localised populations which are unsustainably high due to the activities of humans. These are listed as problem animals and include the Silver Gull, White-winged Chough, Bell Miner, Noisy Miner, Common Brushtail Possum, Eastern Grey Kangaroo and Macquarie Perch (Yarra).

CHAPTER 9

CONSERVATION MEASURES SPANNING SITES

NOTE: The most comprehensive conservation measures recommended by this study are the two Regional Strategies detailed in Chapter 10 Regional Hydrological Strategy and Chapter 11 Regional Habitat Link Strategy. The issues discussed below are subsumed under these strategies.

AREAS OF PARTICULAR CONSERVATION SIGNIFICANCE

Several important categories have been applied to areas of particular conservation significance. These are Ecological Reference Areas, Critical Conservation Areas and Strategic Habitat Links.

Ecological Reference Areas

There are ten Ecological Reference Areas (ERAs) and 20 Critical Conservation Areas (CCAs) proposed for North East Melbourne under the Regional Habitat Link Strategy. CCAs are for threatened species, habitat or assemblage attributes substantially contained on private land and which are inadequately represented in the biological reserve system. ERAs are for these attributes contained in biological reserves. The system of CCAs and ERAs proposed for NEM is the minimum 'safety net' requirement to reduce the event of regional extinction of these attributes. Preservation of the biota of NEM will require the protection of all CCAs and ERAs. The system provides further recognition and protection for the sites of State or National significance that are the most critical for conservation in NEM.

The reference area definition is:

Tracts of viable, relatively undisturbed public land representative of land types that elsewhere have been subjected to extensive modification and use by Europeans (LCC 1977).

Reference areas must be subjected to low levels of artificial management so as to allow ecosystems to develop without human interference. They also need to be surrounded by native vegetation buffers designed to maintain their natural processes and isolate them from external or human-induced influences. These buffers usually require land protection and conservation management.

The study of natural ecosystems in reference areas forms a standard for intactness (a 'control' ecosystem) against which altered systems can be compared. Only restricted access for management and passive scientific research is permitted. Logging, mining and other antagonistic human activities are excluded.

The present reference area system in Victoria is predominantly of mountain forest ecosystems, particularly damp sclerophyll forests. These habitats are not threatened in Victoria and are well represented within biological reserves. The reference area concept in Victoria does not cater for the best examples of some of the most threatened and significant plant and animal communities, habitats and species (e.g. gully woodland, box-stringybark woodland, grassy woodland and plains grassland) occurring on public land of the foothills and plains if these examples cannot meet the supportive criteria (see One Tree Hill site 80).

The system of Ecological Reference Areas (ERAs) in NEM forms a reference set of habitat and landform assemblages. It also contains the most significant occurrences of rare and sensitive species (e.g. butterflies and orchids), habitats and landforms within the biological reserve system. In this context, ERAs are the most fundamentally significant areas in NEM as they offer long-term viability of species populations. The plains and foothills ecosystems of Greater Melbourne have been fragmented by clearing, degraded by land-use and subjected to widespread threatening processes related to human disturbance. Land settlement has been more intense than in mountain forest ecosystems. As such, the lowland ERAs will require active conservation management including revegetation and weed and vermin control programs.

The long-term viability of significant flora and fauna populations contained in ERAs will require minimal human impact and disturbance. Maintaining biological attributes requires continuity of external habitat links

and the implementation of conservation management and strong research-oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies—see chapters 10 and 11). Increased levels of disturbance will disrupt integral ecological processes which provide the ‘control’ sites for scientific research. Restricted public access conditions and nature conservation of all indigenous habitat and potential habitat should be the principal planning/land-use priority.

Management of adjoining private land should be sympathetic to the conservation of flora and fauna. In most cases these areas contain extensions of populations of some threatened species designated within the ERAs. Private land buffers may require legislative controls that protect and enhance native flora and fauna and promote conservation activities. It would be desirable to negotiate conservation covenants or similar conservation agreements as to the management of adjoining freehold bushland.

ERAs contain:

- the most representative ecosystems (e.g. foothill forest) occurring in biological reserves in NEM;
- the most biologically significant, intact and extensive assemblage of constituent habitats within these areas in NEM; and
- the best opportunity for long-term preservation and sanctuary and scientific research of these ecosystems in NEM.

The Ecological Reference Areas lie in nature conservation (biological) reserves set aside for natural ecosystem values. It is important that the ecosystem is able to function properly. Excessive levels of disturbance or public use would be likely to disrupt ecological processes.

Management direction within ERAs should be to preserve the long-term population viability of species and communities. Adjoining land needs to be managed in a way that does not downgrade biological values of the ERA.

Suggested operative conditions for ERAs include:

- conservation and planning controls to enable management in accordance with planning permits, conservation covenants and the regional habitat link and hydrological strategies;
- management for conservation of flora, fauna, natural substrates and the hydrological cycle as the principal land-use;
- priority scientific research and monitoring of threatened species or habitats. This research requires the establishment of permanent reference points and security from interference, uncontrolled fires and disturbance;
- implementation of conservation management in accordance with research guidelines to ensure the retention and enhancement of threatened habitats (including indigenous understorey vegetation), species and faunal assemblages;
- exclusion of general access and earthwork activities (e.g. track making and logging) to minimise the level of human disturbance and maximise the viability of significant flora and fauna populations. Public use will need to be restricted to passive activities in areas of low environmental sensitivity. Acceptable activities include prescription flora management works and nature interpretation;
- full address of environmental impacts on biological significance during planning considerations for any development or recreational proposal which could compromise habitat or environmental quality. This is vital in the determination of future land-use capabilities;
- careful management planning or re-evaluation of adjoining areas subject to recreational or other intensive land-use, so as not to impact detrimentally on designated biological attributes of the ERA;
- external location of public roadways, service easements, fire breaks, access tracks and permanent dwellings (unless already approved and/or operating in accordance with nature conservation guidelines) so as to minimise levels of human disturbance;
- active conservation management including revegetation and erosion, weed and vermin control programs and habitat link restoration works.

Threatening processes to ERAs include:

- perimeter fragmentation and habitat loss, particularly land subdivision and housing. This can be directly equated to loss of biological values within the interior of the conservation area. Household

disturbance including noise would impact on sanctuary values and be likely to have indirect effects including problems with weeds and commensal animals; it may also result in an inability, or at least a lowered flexibility, in the performance of certain management options including preparation of fire breaks and revegetation programs;

- horse riding, off-road vehicle use and recreational activities;
- mining or other substrate removal, logging or native vegetation removal, waste disposal and other non-renewable or primary production land-uses;
- chemical application or other intensive or non-passive uses such as burning, unless as prescribed management such as species enrichment or weed control programs (requiring an appropriate research back-up).

These threatening processes are incompatible with the maintenance of conservation values. Resultant disturbance and weed and vermin invasion causes conflict with management objectives.

Declining biological integrity (e.g. intactness due to habitat loss, disturbance or degradation), loss in connectivity of external habitat links, or inadequate conservation management within or buffering the conservation area, will undermine the long-term viability of ERAs. On present knowledge, the ERAs of NEM are considered important to the conservation of their designated attributes in Victoria.

Critical Conservation Areas

CCAs contain:

- the critical area or most viable population for long-term survival in NEM of a designated threatened species, habitat or assemblage; and
- the most intact or viable stand in NEM of a regionally threatened habitat not fully represented in an Ecological Reference Area.

Suggested constraints/conditions for CCAs include:

- management for the conservation of flora and fauna;
- conservation controls/planning overlays which preserve their designated biological attributes and consolidate the existing and potential occurrences of these attributes under conservation management;
- the full address of environmental impacts on biological significance during planning considerations for any major development, extractive or habitat (including ground and surface water) alteration proposal;
- no alteration to the hydrological cycle or waste disposal;
- no public roadways or service easements (unless already approved or present);
- no mining or substrate or native vegetation removal, logging and other non-renewable land-uses;
- no high level recreational use; and
- the preparation and implementation of a conservation management plan.

CCAs support the key populations of the most critically threatened species, habitats or assemblages in NEM. The preservation of the CCA is considered necessary for the conservation of the designated threatened species, habitat or assemblage in NEM. Each provides a critical component of the life or breeding cycle of migratory fauna. It may be the minimum area which offers the best (and often the only) opportunity for long-term survival of the designated attribute. Declining biological integrity (e.g. intactness and viability due to habitat loss, disturbance or degradation) or loss in connectivity of external habitat links will undermine its ability to support the designated attribute. This is considered likely to lead to extinction of the attribute in NEM. On present knowledge, each CCA is considered critical to the conservation of its designated attribute in Victoria.

A Critical Conservation Area must be of sufficient size to support viable populations. Ten hectares is considered the minimum area required to maintain viable populations of flora and fauna species or habitat/assemblages under effective conservation management. Losses in the short term are usually habitat dependent, or selective, species (e.g. reptiles, freshwater fish and butterflies) or plants (e.g. orchids). In the long term this includes habitats and assemblages. Habitat clearing, disturbance or degradation, severance of

habitat links or inadequate conservation management within or buffering a CCA can be directly equated to an increased probability of eliminating biological attributes.

Functional ecosystems necessarily require adequate internal habitat area and buffers from external disturbances. This is seldom met for a threatened habitat, particularly in the urban area. Shortfalls in area and buffering from edge disturbance would need to be countered by increased conservation management. CCAs containing high edge to interior habitat ratios are difficult to manage and protect. The CCA should be composed of one discrete block or, if comprising several smaller blocks, should be connected by effective habitat links.

All native vegetation and substrates including water are protected in CCAs. Conservation management plans should be prepared for CCAs to ensure the retention and enhancement of the most critically important stands (and their indigenous understorey vegetation) of threatened habitats, species and assemblages occurring on private land in NEM. Achieving appropriate nature conservation management of CCAs may entail acquiring private land. CCAs in urban areas presently designated as public open space would require a re-evaluation of management objectives. Nature conservation should become the highest purpose for the area. A management plan should determine the suitability and appropriate level of public use.

In a rural conservation zone, traditional farming activities are accepted, so long as they do not conflict with conservation purposes. Conservation management plans should be prepared and integrated into farm plans for these areas. These plans should provide for protection of key habitat nodes and strategic habitat links (e.g. streamways), habitat enhancement and natural regeneration. The support and co-operation of government agencies, Councils and landowner groups and the development of a habitat protection incentive scheme is essential.

Environmental Living is accepted in CCAs occurring in bushland conservation areas. These CCAs contain specific guidelines for the retention and enhancement of the most critically important stands (and their indigenous understorey vegetation) of threatened habitats and threatened orchid species in NEM. Any proposed activity or permit for development considered detrimental to maintaining the biological values of a CCA requires the provision of a full Environmental Impact Assessment.

Strategic Habitat Links

Strategic Habitat Links (SHLs) are contained in sites in which habitat link utility is considered critical to the maintenance of faunal/habitat significance in NEM. They also perform a substantial role as wildlife corridors in Greater Melbourne. SHLs form a functional system of inter-connecting regional corridors within the sites of significance (i.e. each connects with another SHL). Thirty-seven of the sites of significance in NEM are designated as Strategic Habitat Links. A detailed discussion is given in Chapter 11 Regional Habitat Link Strategy.

THE IMPORTANCE OF RAILWAY RESERVES

V Line own and manage the railway reserves. Their role is to administer a safe and effective rail system. NRE has an advisory role on issues of conservation. They have the charter to impose conservation measures for critically threatened species. It will be recommended that they take on a similar charter to protect all identified Very High/National sites of biological significance in this study. Deficiencies in communications between NRE and V Line have arisen. Most of the important rail reserve grassland stands in GM have been known to NRE/V Line for a decade (e.g. Stuwe 1986; MacDougall 1987). Over this period 11 of the 12 finest stands in GM have been destroyed or partially destroyed as a result of lack of intensive surveys and tardiness in enforcing safeguards. Efforts by the La Trobe University Botany Department protected the thirteenth site (Manor on the South Western Railway) from being destroyed and prolonged the survival of the last colony of the White Diuris at Tottenham, on the North Western Railway.

There should be negotiation and implementation of a V Line/NRE threatened plant protective agreement over the full length of the North Eastern Railway reserve from Craigieburn to Hernes Swamp. V Line

management of the rail reserve needs to address the conservation of native grasslands (see Hernes Swamp site). Monitoring and management input from NRE will be required.

MINING REGULATIONS AND NATIVE GRASSLAND / ROCK CLEARANCE CONTROLS

The Mines Act regulates the commercial mining of non-renewable resources in Victoria. The commercial growth industry surrounding the extraction or surface stripping of basalt rocks, particularly for cosmetic purposes such as landscaping, needs to be similarly regulated. Stony rises, stony crests and rocky escarpments are the most significant areas for native ground fauna and flora of the volcanic plains grasslands. Areas known or suspected to support vulnerable or endangered grassland species are eligible for protection under State and Commonwealth Government legislation (e.g. Flora and Fauna Guarantee Act of Victoria). Surface stripping should be curtailed in biologically significant areas of the volcanic plains. Any mining proposal must be accompanied by a full and independent Environmental Impact Assessment which addresses the impacts on both biological and physical landscape values including the hydrological cycle. Regulations will need to be formulated and enforced to protect the diminishing volcanic plains grassland habitat as less than 1% of the original extent is now considered intact. The removal of native grassland (e.g. for industrial, agricultural and construction purposes) within a designated site of State or higher biological significance should require a permit. This should not normally be granted. Essential works (e.g. mining and agriculture) would be considered if they comply with the purposes of the Regional Hydrological and Habitat Link Strategies and with permit conditions for appropriate environmental safeguards contained within an environmental impact assessment.

PLENTY–MERRI RIVER RED GUM PROTECTION ZONE

Evidence from fauna studies undertaken in the Plenty Growth Corridor revealed that the total area of River Red Gum woodlands remaining is the **minimum** required to support long-term, viable populations of all its faunal species (Beardsell 1989). One large, contiguous stand under integrated conservation management would maintain trees in a healthier condition and contain a more diverse fauna than smaller isolated stands. The NEROC study proposes that the zone be extended to include all stands of River Red Gum on the Plenty and Merri Plains which contain River Red Gum fauna or habitat attributes of State or High significance as they form an integral component of the same biological system. Areas meeting this stand/significance criteria are contained in the Fenwick and Surrounds, Summerhill Road, Edgars Creek Headwaters, Mernda to Yan Yean and Dunnetts Road Swamp sites (see also this heading in site 15).

Tree clearing, stand fragmentation and residential encroachment each potentially lead to further loss of faunal species. Present land management is continuing the decline in vigour of River Red Gums and the local elimination of many species of beneficial birds. Remnant aged, stressed and defoliated trees may be a prelude to treeless farmland, a scenario that is widespread in River Red Gum areas of Victoria (see Kile *et al.* 1981). The long-term effect of total tree loss would be the loss of wildlife dependent on trees for food, shelter or nest-sites. A major step towards addressing these problems was the incorporation of the area into the Red Gum Protection Zone (MPE 1990).

Reforestation and protection of remnant vegetation are recognised by all levels of government and broad sections of the community as essential to ameliorate major environmental problems in rural Victoria ('greenhouse', land salination, dieback etc.). Pastoral practices in the River Red Gum Protection Zone have led to tree decline and loss of the native understorey and prevented tree and shrub regeneration. These practices have destabilised the native ecosystem by altering natural predator and prey abundances. This has led to loss of beneficial vertebrate and invertebrate biological control agents and increased populations of insect pests of pasture and tree foliage.

Maintaining populations of native flora and fauna species in the River Red Gum Protection Zone will require management which addresses land degradation processes. Many of these processes, such as weed

invasion, soil erosion and salination, have lowered farm productivity. Agricultural studies have shown that the level of livestock health and productivity is higher in paddocks surrounded by effective shelterbelts (Brown & Hall 1968).

The River Red Gum Protection Zone will facilitate conservation management of the River Red Gums. Through participation, the level of public awareness of the value of trees and an understanding of the land and habitat degrading processes operating in the woodlands (and their solutions) will be raised. Tree planting projects such as Greening Australia and LandCare should be consulted for incentives and advice. Objectives of these projects are the promotion and planting of native trees, shrubs and ground vegetation and the retention and protection of remnant natural habitat.

Tree planting projects should aim to establish viable stands of adequate size and diversity which will be able to regenerate and maintain themselves. The best success with these projects is offered by planting indigenous species and fencing off areas for land protection and natural regeneration. An effective long-term result requires a thoroughly researched and coordinated tree planting strategy, taking into account the possible effects of dieback. Many isolated tree plantings in rural Victoria have failed to reach their potential (particularly with regard to the creation of effective faunal habitat) because inappropriate, usually non-indigenous, species were used or there was inadequate provision for ongoing management.

The specific aim of tree planting projects in the River Red Gum Protection Zone should be to establish a network of woodlands linking all existing fragmented stands. Roadside strips of native woodland often contain a diverse avifauna (Loyn & Middleton 1981). Broad or contiguous roadside strips of native woodland vegetation usually contain a higher avifauna diversity and density than narrow or isolated roadside strips (Loyn & Middleton 1981; also see Chapter 5). These corridors may be sufficient for the local movement of beneficial native fauna such as insectivorous birds from nearby natural habitat.

It is documented that trees in large, unfragmented stands live longer, are healthier and are more capable of regeneration than those in small fragmented stands (e.g. Ford 1981, Kile 1981). The findings of the bird census revealed that these stands supported more species and larger populations of beneficial insectivorous birds. It follows that large stands of indigenous habitat planted as balanced ecosystems in their natural environment will overcome damaging human-induced effects more quickly and establish and maintain themselves more successfully. Trees are best protected from defoliating insects when they are growing (or when planted) in stands that provide adequate food, shelter and nesting sites for the predators and parasites of these pests (Davidson 1982).

Elimination of understorey shrubs and saplings by grazing livestock leads to a progressive decline in diversity and density of insectivorous birds (Ford 1981, Ford 1985). The most healthy stands of River Red Gum support the broadest range of structural and floristic diversity. Diversity in the understorey decreases the possibility of selective deleterious insect attack by maintaining a more natural ecological balance (Davidson 1982). Shrub layers under River Red Gums, particularly wattles and prickly plants such as Tree Violet, Hedge Wattle and Sweet Bursaria, provide secure cover and year-round nesting and feeding habitat for small insectivorous birds such as thornbills, flycatchers and wrens. These birds control damaging insects themselves or may act as hosts for insectivorous cuckoos. Tall shrubs will also attract other, habitat-dependent insectivores into River Red Gum areas such as the Rufous and Golden Whistlers, Grey Fantail and Grey Shrike-thrush which may assist in reversing the decline of trees on farms.

Most rural land-use practices in the River Red Gum area have eliminated or reduced the native shrub and field layer plant species and consequently many of the natural insect biological control agents. Native shrubs and herbs are a source of nectar and shelter for invertebrate predators and parasites (e.g. hover fly larvae, family *Syrphidae*, predatory spiders and parasitic wasps) which are natural biological control agents of tree and pasture pests (Davidson 1982). The encouragement of large and diverse populations of natural pest controlling agents into farmlands by tree and shrub planting will reduce the damage caused by pastoral pests and weeds and the rate of chemical applications that are required for their control. This is the basis of a sustainable land management practice.

REGIONAL HABITAT LINK STRATEGY

See Chapter 11 for a detailed discussion of the Strategy.

COMPANION ANIMAL ACT 1994

This bill gives the option and power of enforcement to Local Government. The essence of the bill is to provide uniform legislation for cats and other companion animals with that for dogs to fully address the issue of responsible pet ownership. It provides a definition of the rights and responsibilities of pet owners and the welfare of humans, wildlife and livestock affected by these pets. It is based on an incentive system (e.g. lower registration fees for desexed cats) rather than a sanction system. Registration will be accompanied by educational material on the impact of domestic cats on native wildlife.

Responsible pet ownership awareness and education program

Individuals must help reduce the overall impact of pets on wildlife by being responsible owners in an attempt to reduce, and ideally eliminate, further harassment and predation effects. The main issue regarding domestic cats is to bring in line controls that are already accepted and working for dogs. The nuisance of dogs to humans is arguably greater than that of cats, but the impact of cats on native wildlife is far greater than that of dogs. An active public education program should address the adverse effects on wildlife of unrestricted cat and dog access to parklands. This may stimulate favourable responses to pet cat and dog restrictions (e.g. leashing of dogs on walks and registration of cats) if such conservation controls become adopted. Recent proposals for 'cat and dog regulation zones' are being developed in some municipalities of Greater Melbourne (e.g. Shire of Sherbrooke—Animal Welfare Local Law). These regulations relate to bushland of high significance that abut residential areas. Exposure to habitat fragmentation and degradation has already subjected wildlife in these areas to severe threatening processes.

Successful cat confinement method 1

(Extract from FOWSP Newsletter, July 1992) A construction of an area 6 by 3.5 m and 2.4 m high, enclosed by chicken wire with a gravel floor and a screen door for outside (human) access, was devised. The cats get from the house to the enclosure and back through a cat-flap in one of the windows. The cat-flap is ready-made and can be purchased for about \$45 from a pet shop. It has a catch for keeping the cats in or out or both and is virtually airtight when closed. An old ladder was added as a bird viewing tower and some branches for climbing and boxes for hiding. There is an assortment of balls and cat toys for chasing and murdering and pots of catgrass (Cocksfoot, *Dactylis glomerata*). Cocksfoot is a local creek and roadside weed and catnip and catmint are obtainable from the local garden centre. The cats soon adjusted and seemed delighted with the outdoor atmosphere. The construction should provide access to a grassed area and a sand pit. The materials cost about \$200.

Successful cat confinement method 2

(An interview with Leigh Ahern, former officer with NRE). The house adjoins Kinglake National Park and the surrounding bushland contains a high diversity of native bird life and ground fauna. A clear, 25 m run of plastic clothes-line was set up along the driveway in front of the house. The line can be purchased cheaply from supermarkets. This was set at a height of 2 m and strung between two trees. A 5 m lead of plastic clothes-line attached via a spring catch on a swivel to the cats collar slipped along the run on a split washer. Cats spin around a lot on the lead and unless the swivel works properly the lead becomes knotted. Cats cannot slip a properly adjusted collar because of the 'give' in the plastic line. A stick was attached to the line about 2 m from each extremity to prevent the lead wrapping around the trees. The cat could climb onto, or shelter beneath, basking sites at each end of the line. Birds soon learned the limitations of the cat and confined their activities to the areas beyond. The cat was disconnected from the lead and put into an enclosed area (old car crate) when nobody was home (as a safeguard from the local Goannas and Powerful Owls) and for overnight accommodation. The cat appeared well contented and adjusted. The materials cost about \$30.

CHAPTER 10

REGIONAL HYDROLOGICAL STRATEGY

STRATEGY OBJECTIVES

- To outline a long-term initiative to improve and restore as far as possible the natural flow rates and water quality of all streams.
- To improve critically low summer-autumn stream flows.
- To assess, arrest and reverse the threatening processes that are restricting the long term viability of rare or threatened species of streamways (see definitions) in NEM.
- To assess, arrest and reverse the threatening processes that are operating on species undergoing decline and the conservation of which is valued as important in the context of NEM (i.e. regionally threatened, rare or depleted species). This includes species such as the Platypus, Rainbow Bee-eater and Freshwater Blackfish and their habitats and prey.
- To enhance the native instream fauna in all streams.
- To demonstrate the need for whole catchment managements including riparian and streamway revegetation plans for all streams.
- To advocate wise water uses and ensure that clean water flows into streams and the bay.
- To ensure that full environmental impact assessments are prepared for developments along streamways or that affect waterways, especially assessing cumulative effects downstream.
- To scientifically monitor all the above objectives.

An Overview

The basic tenet of the strategy is to slow down and ultimately reverse the processes by which we have been undermining one of our life support systems. There must be comprehensive and fully integrated reforms in government policy and community attitude towards land and water management to restore the streams. The need for a regional hydrological strategy arises from 150 years of land settlement during which we have failed to provide sustainable conservation management of our waterways. Water was viewed as a renewable resource—which is more or less true—but the natural systems upon which it depends are not. The resource supplied by streams, and particularly the quantity and quality of the water, is finite. The costs of the economic and social gains made have been environmental degradation and losses in conservation values. Costly artificial waterways and storages such as channels, drains and dams are carefully managed, but since stream water comes cheaply it is valued cheaply and managed wastefully. Clearing riparian forests and grazing stream banks was viewed as necessary to sustain the economic profitability of farmland. The same view pervades the ethic behind the dumping of industrial and urban effluent into streams—long-term losses for short-term gains.

Loss of natural aquatic ecosystem values is equivalent to loss of life quality, both for the indigenous flora and fauna and the present human inhabitants. All are dependent on the water cycle but this has been modified and degraded from beginning to end. Thoughtless management leading to salinity and pollution problems has led to a situation where government and community must face and redress the causes. Effective solutions and conservation gains will come neither cheaply nor easily. Implementation of a regional conservation strategy encompassing all streams is the most efficient approach to the problems.

Definitions

Streams are defined as those carrying a water flow for more than four months a year. The riparian zone is the area to 10 m of either side of the edge of the normal flow of water. The area of streams encompassed under the strategy is referred to as the streamway. The streamway is defined as being a 100 m strip to either side of the upper bank escarpment of minor or narrow major streams (e.g. Merri Creek gorge) and the entire floodplain and lower valley slopes (to 100 m from the edge of the floodplain) of major streams. The latter category of major streams is defined as those containing a floodplain which is inundated at least on an annual cycle.

The strategy

The primary objective of the strategy is the conservation of native flora and fauna of all streams in all municipalities. This requires broad-scale improvement in stream conditions and water conservation management practices. The present deleterious impact upon and use of stream water by humans is reducing the distribution and abundance of native instream species. This impact must be addressed. These unnatural changes to aquatic ecosystems are detrimental and far-reaching and the environmental effects of any further possible detrimental changes must be fully considered. There is great scope for controlling and eliminating many of the threatening processes acting on streams.

The strategy has been devised in an attempt to generate action. Every human has some deleterious effect on the streams. Every human is capable of doing something about it. Watercourses have been particularly affected by a combination of poor farming and/or land management practices, urbanisation and the resultant discharges of sewerage effluent and industrial wastes and reduced water flows (McKenzie & O'Connor 1989). Human disruption of the natural hydrological cycle, elimination and degradation of streamway habitats and depletion of streamway fauna has been dramatic. The effects range from visible physical alterations to subtle chemical or microfaunal changes in the ecological balances of streamway ecosystems. Threatening processes arising from past, present and likely future land settlement are increasing (see Stream Degradation Chapter 8).

The streamway conservation zone as integral habitat links

The connectivity of habitat links throughout NEM is maintained by streams. Only the headwaters of some streams are considered to be in a healthy or natural state. Weak links, such as the Yallambie–Greensborough section of the Plenty River, the Eltham township section of Diamond Creek and the Plenty River East Branch below Toorourrong Reservoir, have weakened the systems for instream fauna. These sections are major bottlenecks for faunal movement. Improving the water quantity and quality from upstream sections would enhance the conservation significance of downstream ecosystems, particularly for instream vertebrates and invertebrates.

MANAGEMENT ISSUES AND RESEARCH RECOMMENDATIONS

The following discussion and recommendations deal in turn with seven major management issues identified for streams in the study area:

- 1 depletion of natural flow rates of streams;
- 2 declining water and instream habitat quality;
- 3 riparian habitat destruction and tree removal and decline;
- 4 streamway floodplain habitat destruction (a) wetlands (b) woodlands and shrublands;
- 5 instream habitat destruction;
- 6 rare or threatened fauna species of streams;
- 7 poor public awareness of and attitudes to streams.

ISSUE 1: Depletion of natural flow rates of streams

The amount of water determines the amount of habitat available for fish. Stream flow is the major source of water oxygenation and flushing of built-up contaminants. Inadequate summer–autumn flows appear the most

critical problem. Long periods of low flow lead to water lacking in oxygen and substrates with excessive accumulations of contaminants and silt. The instream biota is dependent on the maintenance of adequate flow. The autumn flow of second and third order streams is severely depleted by water storage reservoirs, farm dams and water diversion for rural use in the catchments. Outflows from deep reservoirs are usually cold, nutrient-poor and low in dissolved oxygen levels. Each of these factors may affect the breeding and feeding activity and metabolic rate of native fish (Koehn & O'Connor 1990). The first flow after early autumn rainfall episodes is restricted because water storages are usually down in capacity, so must fill before overflowing, preventing runoff from entering streams. This may affect the precisely timed movements and breeding of migratory fish species (e.g. galaxias) as these are instigated by rising autumn flows.

Studies:

- S1.1 Stream flow.** Seasonal stream flow studies should be undertaken to determine critical flow regimes for all stages of the life cycle of native fish and their invertebrate prey species. Stream flow is closely related to substrate structure. Both this and the water and habitat quality studies (Issue 2) should be integrated.
- S1.2 Impact of altered flooding regimes on fauna.** Fauna studies are required to assess the impact of altered flooding regimes caused by flood mitigation works such as stream impoundments, retarding basins and weirs. This is particularly relevant to the migration and breeding cycles of fish species such as the galaxias.

Actions:

- A1.1 Restore natural flow rates to streams.**
- A1.2 Improve critical low and seasonally altered flow rates of streams,** particularly to cater for critical spawning/migration requirements of fish. More natural stream flow conditions at other times of the year should be provided.
- A1.3 Restrict non-essential new dam constructions** in the catchments. Possible loss of direct flow into second and third order streams due to the proposed construction of a dam would require a permit and the plans need to conform to the purposes of the stream flow plan and Regional Hydrological Strategy (e.g. provision of a fish-way if an instream dam).
- A1.4 Develop a system of strategic release of excess water from dams** during low flow periods of streams.

ISSUE 2: Declining water and instream habitat quality

None of the lower and middle reaches of streams in NEM are considered to be in a predominantly natural state. The blanketing of substrates by sediments is critically limiting the breeding opportunity of species such as the Freshwater Blackfish and feeding opportunity of species such as the Southern Pigmy Perch and Platypus. Improving these opportunities in any section of a stream requires a broad picture of the entire catchment management. The condition of downstream water quality is a direct reflection of this management. Degrading activities that lower the water quality of an upstream section will lower the water quality of all downstream sections. Summer wastewater discharges and runoff comprise the main flow of urban 2nd order streams. This is at least 50% of the normal summer flow in all streams and as high as 90% in some streams (e.g. Darebin Creek).

Studies:

- S2.1 Instream bio-physical properties.** Undertake instream invertebrate, plant (including bryophytes, which are important bio-indicators of water quality) and habitat studies of all streams. Assess the adequacy of instream plants in preventing algal blooms and water de-oxygenation and eutrophication by providing oxygen and essential nutrients and removing harmful toxicants and suspended matter. The presence or lack of aquatic vegetation is a large determinant of the faunal composition. Instream structures and substrate configurations and components also determine the

faunal composition. High diversity in each of these physical groups and in aquatic and bank vegetation yields higher instream faunal diversity. The diversity of instream structures such as logs, rocks and tree roots, substrate configurations such as running riffles, slackwater pools, channels and bank undercuts and substrate components such as sheet rock, gravel, pebbles, cobbles and silt should be assessed.

S2.2 Instream chemical properties. Undertake seasonal monitoring analyses in all streams of chemical properties that are a consequence of human settlement in the catchment. These should include tests for heavy metals, chlorinated hydrocarbons such as pesticides and herbicides, *E. coli* bacteria, salinity, siltation, turbidity, pH, dissolved oxygen and organic and inorganic phosphates and nitrates.

S2.3 Siltation. Document all major erosion point sources of stream turbidity arising from earthworks including dam, road and building constructions, mining and logging operations and livestock trampling.

Actions:

A2.1 Control water pollution sources. Polluted urban and farmland runoff is endangering downstream ecosystems. Individual sections of streams require the combined ecosystems to operate adequately before ecological processes can fully function. The collapse of an ecosystem in one section will likely lead to collapse in lower sections of the stream. All major water pollution sources including erosion sources, stormwater drains and nutrient enriched sewerage and factory effluents should be controlled and monitored. There should be restricted use of fertilisers and other chemicals including pesticides and herbicides along streamways and in offstream locations where runoff into streams can occur. Mandatory tests for water contamination from insecticides, *E. coli*, heavy metals, nitrates and phosphates should be conducted in all streams flowing into populated regions of the Yarra River. For instance in the 1950s and '60s, car manufacturers under the direction of the Victorian Government are reliably reported to have dumped tons, perhaps hundreds of tons, of cyanide contaminated waste in a number of mineshafts in the Shire of Eltham. Documentation needs to be made available on the locations and life expectancy of the canisters and a thorough examination of the watertable and streams conducted for seepage of this toxic material.

A2.2 Reduce streamway disturbance in urban and public access areas caused by human recreational activities This includes worm digging by anglers, which is leading to loss of native vegetation cover, bank destabilisation and weed and vermin invasion (e.g. Wilson Reserve on the Yarra River at Ivanhoe and Watsons Creek at Oxley Bridge at Kangaroo Ground). Public access points need to be controlled.

A2.3 Community education about urban stream pollution and wastewater which aims at reducing the output of polluted urban wastewater. Water is imported to Melbourne's reticulated system at great financial and environmental cost. It is exported as waste along with domestic refuse such as plastics into the waterways and Port Phillip Bay at greater cost to the environment (and finance if the beach and bay is to be cleaned up). The production of this waste needs to be rationalised. Water pollution output can be reduced through waste minimisation and innovative treatment processes. To break the waste production cycle future cities must move toward local use of water and local recycling of waste.

There are obvious targets which would lead to reduction in water use. Storing rainwater that falls onto roofs and overloads stormwater systems to recycle for watering the garden or flushing the toilet. Educating people about excessive watering of lawns and ornamental house gardens, and promoting species that require less water (e.g. indigenous natives). Washing cars in streets and driveways with a hose can be restricted and a bucket used instead. The residue could be flushed down the sewer and not the stormwater. Hard surfaces of concrete and asphalt need to be replaced by absorption strata such as vegetation to slow the surface runoff. Urban street and pavement runoff should be retained and turned into an asset such as a wildlife pond containing native fish (such as

pigmy perch that control mosquitos). The aquatic vegetation acts as a filtration area, the overflow may then pass into the waterways or in turn be used to irrigate house gardens and parklands.

Household water in outlying unsewered subdivisions could pass into well designed reed bed and sand filtration systems. It might be technically possible to produce the above system at much the same cost as it takes to establish the normal stormwater infrastructure. Perhaps the costs may initially be greater but savings would be generated in the long term. Provisions for more open space parklands should be required out of planning subdivisions. Remnant native vegetation must be incorporated into the parklands wherever possible and areas will need to be extensive enough and contain effective external links to avoid eucalyptus dieback problems (see Regional Habitat Link Strategy).

- A2.4 Install offstream sewage filtration farm.** The instream biota of Merri Creek and Plenty River is being threatened by nutrient-rich effluent from sewage treatment plants. Discharge into the streams from existing treatment plants has already caused a serious decline in water quality and instream fauna species (e.g. Freshwater Blackfish and Platypus). The only plausible option which will maintain and, hopefully, improve water quality in Merri Creek and the Plenty River under the projected urban growth, is the development of a 'state of the art', scaled down version of the Werribee Sewage Farm which services existing outlying urban areas such as Craigieburn, rural townships such as Whittlesea and Wallan and the entire growth area of the Merri-Plenty Valley. This should be a grass and pondage filtration system. No discharge should be able to reach the streams. Given the importance of the local population of waterbirds and the substantial loss of wetland habitat in the Plenty River system, the sewage farm design should maximise waterbird conservation. It should contain a diversity of wetland habitats and ample cover of fringing vegetation and woodlands, serving as an effective replacement wetlands area.
- A2.5 Improve water and habitat quality for threatened fish species** (e.g. Broad-finned Galaxias) and restore others (e.g. Spotted Galaxias and Australian Grayling; see fish-way at Dights Falls). A major improvement is needed in the water and native instream and riparian habitat quality of all streams. Despite the excellent habitat works in some sections of streams (e.g. Yarra Valley Park) the essential quality of the water and instream habitat is still inadequate.
- A2.6 Reduce erosion and saline groundwater entry** from poorly managed land in the catchments. The level of land protection and conservation management must be enhanced on these farms, particularly the streamways and the gullies leading off steep hills. Heavily cleared water catchment areas of Arthurs Creek (e.g. Stewart Ponds Creek) and Darebin Creek (e.g. Eden Hills) should be targeted for major land protection and revegetation works. Native vegetation clearance controls should apply to all significant areas of habitat and habitat substrates within the catchments.

ISSUE 3: Riparian habitat destruction and tree removal and decline

Most fish (e.g. Freshwater Blackfish and Mountain Galaxias) are as dependent on trees and shrubs at the waters edge for cover and food as birds are. On the plains, the smaller 2nd and 3rd order creeks contain shallow, static pools in late summer and early autumn. Clearing tall riparian shrubs and overhanging trees, which shaded and sheltered the pools, has exposed the creeks to wind and sun. This causes them to overheat and undergo high evaporation rates. In extreme cases in summer they become devoid of oxygen. Nutrient enrichment occurs because of lack of clear water flow, livestock access, runoff from paddocks, and input of contaminated domestic water. These processes in combination can lead to algal blooms and eutrophication and, in extreme cases, water toxification.

Through heavy clearing and degrading land-use, few intact or extensive stands of riparian vegetation remain. Within NEM, less than 20% of the streamway riparian habitat is contained on public land. Possibly less than half of this is effectively managed for conservation. There is little effective management on any of the private land frontages. The riparian vegetation is important for several threatened species (e.g. Grey Goshawk, Barking Owl, Swift Parrot, Regent Honeyeater and Eastern Broad-nosed Bat). Accordingly, all

native riparian vegetation in the lowlands and foothills of NEM at environmental risk state-wide (Category 1) (Frood & Calder 1987).

Studies:

- S3.1 Assess the impact of removal or modification of native riparian vegetation on the fauna.** Establish long-term bird census reference plots and monitoring studies along streamways, including Bell Miner areas. Establish plots in revegetation areas.
- S3.2 Dieback research.** Investigate the decline of River Red Gums and Swamp Gums and the advance of Sharp Rush along streams on the volcanic plains. Determine whether these are related to rising salinity levels. Research the effects of loss of habitat links as a cause of insectivorous bird declines, foliage insect infestations and eucalyptus dieback.

Actions:

- A3.1 Integrate streamway conservation.** All streamways in NEM are in need of effective and integrated catchment management. Streamway conservation should apply in sites of regional faunal significance or medium habitat significance and higher. A terrestrial and aquatic streamway revegetation plan to functionally network all streamway habitat links and sites of significance should be formulated for all streams in NEM (see Regional Habitat Link Strategy). Where these correspond to sites of state or higher faunal significance, they need to be appropriately managed for conservation.
- A3.2 Protect riparian land** and prevent further stream bank and channel erosion and habitat loss. This will mean restricting livestock entry, earthworks and removal of native habitat (including substrate logs, rocks and soil) from all streamways. These activities should be subject to approval only under strict permit conditions. Native vegetation clearance controls should apply to all significant streamways
- A3.3 Revegetate plains riparian woodland.** Excluding stock from streamways will allow this to occur naturally in most sections of streams. Treeless sections will require extensive replanting of River Red Gums (Merri Creek) or Manna and Swamp Gums (middle reaches of Plenty River and Yarra River).
- A3.4 Reduce riparian weed advance.** Effective and integrated control of riparian weed species (see Pest Plants and Animals, chapter 8) is urgently required. Species which are mostly confined to the damp floodplains and valleys in degraded rural residential and township sections are advancing into natural sections (e.g. Plenty Gorge) due to residential encroachment. With them comes vermin such as Black Rats, snails and slugs, which eliminate native plant and animal species. In degraded sections of streams Blackberry, Willow and Hawthorn often provide the only important faunal habitat (e.g. for Nankeen Night Herons, White-browed Scrubwrens, Eastern Yellow Robins, Gang-gang Cockatoos and Golden Whistlers) or are essential for stream bank stabilisation. They also harbour vermin such as Blackbirds, rabbits and foxes, which eliminate native fauna and spread weeds. Control of these weeds will require careful monitoring and immediate follow-up replacement with native riparian plant species.

ISSUE 4a: Streamway floodplain habitat destruction—wetlands

The hydrology of most of the freshwater wetlands on the plains has been extensively modified as a result of draining, damming, cultivation and stock grazing. In swamps, drains have eliminated or limited the extent and depth of water and period of inundation. Farm dams in catchments restrict floodplain swamps from filling and drainage lines from running unless heavy and prolonged rainfall episodes occur. As a result, when clay substrate swamps dry during summer, they become deeply cracked and display poor water retention capability. Stock grazing has selectively removed shrub and herb cover from wetlands and prevented tree regeneration. Herbfields and mudflats at many wetlands have been trampled and pugged, and the water fouled. Most of the fertile, self-mulching black clay soils of freshwater meadows on the streamways of the plains are plastic and

sticky when wet and have been cultivated for fodder or cereal crops when moisture conditions were low. Land management including cultivation and intensive livestock grazing has promoted pasture grasses and weeds including Chilean Needle-grass, Toowoomba Canary-grass, Paspalum and Ox-tongue. In contrast to native grassy wetland flora, the weeds are largely adapted to agricultural disturbances and have replaced native species in these altered environments.

The near complete loss and degradation of floodplain wetlands has chronically depleted and highly fragmented stands of wetland vegetation (e.g. paperbark swamps and grassy freshwater meadows). These wetlands contain several threatened fauna species (e.g. Lewin's Rail, Australasian Bittern and Glossy Grass Skink). Several native fauna species became regionally or locally extinct as their feeding and breeding habitat was eliminated. These included birds (e.g. Magpie Goose and Brolga), reptiles (e.g. Swamp Skink), fish (e.g. Tasmanian Mudfish and Yarra Pigmy Perch) and invertebrates (e.g. Hemiphysalis Damsel).

ISSUE 4b: Streamway floodplain habitat destruction—woodlands and shrublands

These are both very poorly represented in reserves, both in Victoria and in NEM. Through heavy clearing and degrading land-use, few intact or extensive stands remain. There is little effective conservation management of woodland and shrubland habitats along streamways on private land. These habitats are extremely important for the Swift Parrot and Barking Owl in NEM. Several native fauna species became regionally or locally extinct as their feeding and breeding habitat was eliminated. These included birds (e.g. Bush Stone-curlew, Superb Parrot and Grey-crowned Babbler), reptiles (e.g. Southern Lined Earless Dragon) and invertebrates (e.g. Large Ant-blue butterfly). Accordingly, all floodplain riparian woodland and grassy woodland vegetation in the lowlands and foothills of NEM is listed as being at environmental risk throughout Victoria (Category 1).

Studies:

S4.1 Assess impact of removal or modification of native floodplain vegetation on fauna. This should be integrated with ecological studies recommended under the Regional Habitat Link Strategy.

Actions:

A4.1 Address revegetation and land protection works to counteract the virtual total loss and degradation of offstream floodplain wetlands throughout NEM. Remaining wetlands such as Dunnetts Road Swamp at Yan Yean, Towts Swamp at Glenvale and Challenger Street Swamp at Diamond Creek, need to be protected.

A4.2 Protect streamway habitat nodes. A network of streamway habitat nodes should be developed for conservation works along all streams of NEM. The long-term goal of the Regional Habitat Link Strategy should be to link all these nodes. Habitat nodes contain extensive or intact stands of native vegetation and diverse avifaunal communities and are often centred around minor road crossings (e.g. Eagles Nest Road on Arthurs Creek). They often contain public land from which the works can radiate out. More streamway reserves managed for conservation are required and ideally a parcel of public land should be acquired at each habitat node. Conservation works should be conducted on all existing public land habitat along streamways. Works should be mandatory for those contained in sites of state or higher faunal significance.

A4.3 Revegetation of missing streamway links. Sections lacking in native riparian and offstream tree and shrub cover (e.g. the section of Arthurs Creek between Nutfield and Arthurs Creek township and much of Merri Creek) should be targeted for replanting works. The riparian and offstream strips along most sections of streams are insufficiently wide to provide adequate food and cover for the instream fauna or function as effective terrestrial fauna corridors. Movement and long-term survival of many important species of grassy woodland foliage insectivores such as the migratory Rufous Whistler and nomadic Spotted Pardalote, will require an unbroken revegetated

buffer over the full width of streamways. Gaps along sections of streams prevent these species dispersing to downstream sections. The floodplain grassy woodlands are critical for winter movements into the lowlands of several upland species (e.g. Gang-gang Cockatoo, Olive Whistler, White-eared Honeyeater and Pied Currawong). These species only enter urban sections of lowland streams such as the Plenty River/Yarra River confluence where effective links to the ranges remain. They formerly extended to the mouth of the Yarra.

A4.4 Refuse tips and stream contamination. Quarry tips on the volcanic plains should be no closer than 1 km to major streams to prevent likely groundwater exchange (such as the Cooper Street tips with Merri Creek and the Gordons Lane tip with the Plenty River). Valley land-fill tips are very damaging to instream ecology as creeklines form sumps for highly polluted tip leachate. In summer this forms the major flow, which finds its way into the Yarra River basin through feeder creeks (e.g. Kangaroo Ground tip to Pretty Hill Creek, to Dry Creek to Diamond Creek to Yarra River).

ISSUE 5: Instream habitat destruction

Stream flow regulation works have been conducted on the lower and middle reaches of most 2nd order streams. These works include the de-snagging and clearance of riparian vegetation (including alien species such as willows), stream channelling and alignment and reclamation, or draining of floodplain swamps and lagoons to facilitate more rapid removal of floodwater. The impact of stream flow regulation has been a major cause (along with poor water quality) of the serious decline or elimination of Platypus and Freshwater Blackfish from the 2nd order streams.

Actions:

A5.1 Deleterious effect on habitat quality by stream flow regulation. Avoid instream earthworks. Offstream works should always consider aspects of instream conservation and environmental effects as a high priority.

A5.2 Reduce alien fish advance. Conduct survey and research on the ecology (including competition and predation effects) and spread of alien fish. Research should determine suitable methods of reducing these species. With the presence of seemingly non-eradicable populations of alien fish in the streams, breeding populations of some threatened species such as the Australian Grayling and Spotted Galaxias may never re-establish. Alien species presenting the greatest threat are the Roach, Redfin, Mosquito Fish and Brown Trout. Loach are spreading in the lower reaches of streams in the Yarra catchment. European Carp constitute a substantial threat to instream herbfields of the Yarra. No alien fish including Brown Trout should be permitted to be introduced or relocated into non-captive waters of the Yarra River basin.

ISSUE 6: Rare or threatened fauna species of streams

There are numerous rare or threatened species and regionally significant species wholly dependent on streamways or for which 50% or more observations in NEM were made along streamways. Instream species such as the Platypus and a majority of the native fish, which may survive in healthy sections, undertake seasonal movements which necessitate the negotiation of polluted and degraded sections or instream barriers such as weirs and dam walls. Their numbers have dwindled throughout (e.g. Common Galaxias) and some have been eliminated (e.g. Spotted Galaxias) or are far along the process of elimination (e.g. Platypus), from entire streams. Sedentary species which were formerly widespread have been knocked out from large sections (e.g. Southern Pigmy Perch from the lower Diamond Creek).

Studies:

S6.1 Rare or threatened flora and fauna species. Assess the threatening processes that are restricting the long term viability of rare species with declining populations such as the Platypus,

Rainbow Bee-eater and Freshwater Blackfish and their habitats and prey. Detailed ecological studies should be undertaken on these species.

- S6.2 Fish survey scientific reference points.** The 52 electrofishing sites of NEM have been established as scientific reference points. With the establishment of an effective fish-way at Dights Falls (the version installed in autumn 1993 is apparently ineffective for some species) these sites should be resurveyed. This will provide for comparisons with the pre-construction data and feedback on the effectiveness of the construction.

Actions:

- A6.1 Decline of rare/threatened species and advance of their threatening processes.** Guidelines for the cause and control of these processes and recovery plans should be prepared for declining fauna species. This would enhance the conservation values of all native instream and riparian fauna.
- A6.2 Restrictions on the fishing of Freshwater Blackfish.** The fishing of Blackfish in designated sections of second and third order streams (e.g. Watsons Creek) should be prohibited as these form some of only a few populations considered secure in NEM (see later section).
- A6.3 Fish-way at Dights Falls.** Thirteen visits were made to the Yarra River below Dights Falls during an electrofishing study conducted in 1991 and early 1992 (Tarmo Raadik pers. comm.). The study revealed that three threatened migratory fish species (Australian Grayling, Tasmanian Mudfish and Spotted Galaxias) cannot negotiate the weir. Several common species can only negotiate the weir in low numbers (Common Galaxias), or not at all (Tupong). The design of the 1993 fish-way needs modification to be effective for the passage of all these migratory fish.
- A6.4 Unimpeded passages to migratory fish in all streams.** All streams in NEM have at least partial barriers to migratory fish. The streams must be made free of impassable barriers (e.g. removal of weir in the Plenty River at Maroondah pipeline, Janefield). The unimpeded passage of fish throughout streams is crucial for spawning migration, recolonisation and habitat selection for 70% of all species of native fish in coastal drainages (Koehn & O'Connor 1990). Fish-ways will need to be designed and constructed for all barriers. The future construction of dams across major waterways should not be approved unless they are provided with satisfactory hydrological and environmental effects statements and incorporate an effective fish-way in the design.

ISSUE 7: Poor public awareness and attitudes to streams

Streams are the end-point and accretion area for many threatening processes. The level of degradation in urban areas attracts further abuse.

Actions:

- A7.1 Community streamway awareness and protection.** The apparent and widespread negative public image of streams needs to be raised if the necessary community involvement required for 'clean-ups' is to be recruited. An education and public awareness program should be conducted which profiles the plight and importance of streams, both as viable ecosystems and as aesthetically attractive public utilities. Future water quality improvement in critical mid-reach sections of streams (which are the most significant waters for native fish) is dependent on conservation management of streams in catchment farmland and cleaner wastewater runoff (including sewage treatment plant effluent) from outlying urban and industrial areas (e.g. Craigieburn) and rural townships (e.g. Wallan).
- A7.2 Whole catchment conservation controls and management by government authorities.** Most of the urban and farmland sections of streams in NEM are viewed functionally as drains by most public planning authorities. They are viewed by ecologists as critically important but dying ecosystems, raising a huge question about the health and viability of the ecosystems of Port Phillip Bay. This latter view must be imparted to planners and the community at large. The

level of degradation practices of streams will need to be rectified. Some examples are streamway reserves used as storage areas for road-making materials by Vic Roads, for telegraph poles by the SEC and as rail management access and storage areas by V Line; and the current lack of conservation activities for sections of streams managed by local and state government authorities. De-snagging projects should cease on the grounds that they remove fish habitat. De-snagged areas may need replacements (e.g. clay pipe for breeding blackfish). So often in our streams, sections receiving management in parks (e.g. Plenty Gorge Park), lie downstream of grossly degraded and totally unmanaged sections (e.g. Plenty River at Yan Yean). A whole catchment approach is essential if managing authorities are to make headway into serious urban conservation issues such as improving the water quality of streams and community attitudes to them.

PLANNING RECOMMENDATIONS

Streamway Conservation

The fish and streamway fauna are under threat throughout NEM. The key recommendation of the Regional Hydrological Strategy is the protection and revegetation of all land occurring within 100 m of the break of slope of escarpments of all streams (see definitions) in NEM. To achieve this objective councils will need to consider implementing a planning overlay that protects all streamway land, including farmland, open space, and industrial, commercial and residential land in urban areas. Local and state government authorities should develop an education program that nurtures landowner awareness of the value of buffering habitat on private land in restoring streamway habitat links.

Purpose

Rezoning the floodplain area. The entire riparian strip and adjacent areas of natural bushland on private land (e.g. Yellow Box–Candlebark grassy woodland on the upper floodplain of Arthurs and Deep creeks) should be rezoned to maximise habitat protection, which the current zoning does not provide. This should be accompanied by the development of a habitat protection incentive scheme.

Strips on farmland with a native-dominated field layer should be fenced and grazing impact on them from livestock should be reduced. A similar plan should be devised for re-establishing a viable habitat link encompassing the escarpments along the river. This would require revegetating or replanting the streamway—a strip at least 100 m wide to each side of the break of slope. Funding assistance should be gained for fencing and follow-up weed control and replanting. This should aim to raise the rate of faunal population exchanges within the site and to upstream and downstream along the riparian corridor. Re-establishment of habitat links along the streams would increase faunal values (e.g. habitat for Common Wombats).

CHAPTER 11

REGIONAL HABITAT LINK STRATEGY

BACKGROUND TO HABITAT LINK STRATEGY

[**Note:** The strategy has been written using examples from grasslands and grassy woodlands. The strategy applies equally to forests, although specific examples have not been cited.]

The open grassy terrain and well-watered, fertile soils of lowland grassy woodlands were selected by pastoralists and came under heavy clearing, grazing and cropping pressure. suited relatively dense rural settlement. Subsequent deforestation and habitat degradation led to severe environmental deterioration such as soil erosion and salination. These threatening processes continue to operate throughout Victoria (Woodgate & Black 1988). Ungrazed and uncultivated areas containing the major components of the original native grassland understorey now only occur in some cemetery, railway and roadside reserves. Few stands of native shrubs and only isolated trees remain in most intensively farmed areas that once supported grassy woodland.

Three of the seven most threatened plant communities in urgent need of conservation in Victoria comprise lowland grassland and grassy woodland dominance associations (Frood & Calder 1987). Large tracts of grassland on the Western Volcanic Plains (and elsewhere) are now extremely rare (Stuwe 1986). Components of their fauna are threatened and are in urgent need of preservation. Their resident invertebrate fauna has been little studied and is poorly known but is likely to contain species in need of urgent conservation measures (Vaughan 1988). Remnant grassy woodlands and grasslands are a significant resource in terms of their contribution to:

- 1 environmental protection (e.g. salinity and erosion control, native habitat refugia of increasing importance under 'greenhouse', propagule sources for revegetation and regeneration programs);
- 2 ecosystem function (e.g. recycling of essential elements, maintenance of hydrological cycle);
- 3 conservation of rare or threatened flora and fauna and habitats (e.g. habitat for 9 of the 25 most threatened terrestrial vertebrate faunal species of Victoria, DCE 1991);
- 4 economy (e.g. habitat for native species essential for medicine and food or which act as biological control agents necessary for sustainable agriculture and forestry practices, provision of stock shelter and firewood, benefit to apiculture and land values);
- 5 scientific research (e.g. animal and plant ecology, reference areas for improving our understanding of ecosystems and interspecific and intraspecific interactions, Aboriginal archaeology/ecology);
- 6 recreation, landscape and artistic amenity.

STRATEGY OBJECTIVES

- To re-establish functional habitat links, both internal and external to sites of significance, for the long-term viability of faunal populations.
- To break down the degree of isolation of faunal populations and conserve rare or threatened fauna species.
- To assess the threatening processes on these species and their habitats and prepare guidelines on the cause and control of these processes.
- To raise the viability of habitat patches for breeding populations of beneficial birds and improve them as habitat links for bird dispersal.
- To determine the habitat requirements and relationship between the winter flowering Red Ironbarks and Yellow Gums and nectar feeding birds.
- To improve the viability of stands of Red Ironbark and Yellow Gum for the endangered Regent Honeyeater.

- To establish more effective grassy woodland corridors to maintain and enhance faunal population exchange within and to biological reserves in NEM
- To ascertain the stand size and degree of connectivity required of grassy woodlands to support viable populations of beneficial foliage birds.
- To control River Red Gum and Swamp Gum dieback, the rate of which is directly related to the degree of habitat fragmentation and modification.
- To identify the decline and promote the recovery of rare mammal species including the Common Long-nosed Bandicoot, Brush-tailed Phascogale, Eastern Broad-nosed Bat and Large-footed Myotis.
- To establish a more effective riparian corridor to maintain and enhance faunal population exchanges within strategic habitat sites along streams and to upstream and downstream sites of significance.
- To protect identified sites of faunal and habitat significance, their resident plant and animal communities and most particularly, their threatened flora and fauna.
- To maintain the viability of populations in small remnants. Isolated populations of certain species run the risk of inbreeding. This can lead to poor reproductive success or to individuals with less ability to survive changing environmental conditions. The longer such an isolated situation continues the more likely it is that a species will become locally extinct.
- To increase the diversity of species in remnants. With the establishment of adequate habitat links, more species will have the opportunity to access previously isolated remnants and the overall diversity will increase. This generally results in a more balanced ecosystem with greater long-term viability.
- To ensure the movement of migratory species that require intact vegetation or waterways for dispersal.
- To reduce the susceptibility of plant species to disease. An example of this is eucalypt dieback, where a combination of factors result in the death of trees. The contributing factors include changes to drainage patterns and nutrient enrichment, the loss of understorey shrubs and the insectivorous birds requiring such cover, and a consequent increase in insect attack on the trees. By increasing the understorey cover and establishing vegetated links to more substantial habitat areas, insectivorous birds will be encouraged and the level of dieback reduced.

Most of the land providing habitat links for fauna or connectivity for vegetation in the lowlands and foothills of NEM is under private ownership. The habitat types most often represented on this land are threatened and poorly represented in the biological reserve system. It is recommended the Regional Habitat Link Strategy should be the basis for statutory controls in the form of planning zones or overlays to protect the habitat links and nodes occurring on private land. The strategy is based on intensive biological surveys; the planning zones would serve as a model for land planners and managers to provide the best possible outcome for flora and fauna conservation.

As previously explained, a large proportion of the study area has lost its native vegetation cover due to urbanisation, timber extraction, rural industry, bush block development, inadequate land management especially in terms of controlling weed and pest animals, and the incursions of grazing stock into intact bushland and grassland. This has led to the increasing isolation and decreasing viability of the remaining habitat remnants. Many of the existing habitat links are subject to degradation or threatened by future development. The combined effect for grasslands and grassy woodlands has been the local extinction of over 20 species and a steady decline in population levels of the majority of native species.

MANAGEMENT ISSUES AND RECOMMENDATIONS

Recommendations on protecting habitats and species and on strengthening habitat links are provided in each site treatment where relevant. The regional strategy provides an overview to address widespread issues efficiently and effectively.

The major habitat links are indicated on Map 3 with arrows indicating the best opportunity for effective links between sites. All habitat links should be protected, but priority should be given to strategic habitat links (double arrow).

It is apparent from Map 3 that the waterways and their bordering vegetation are particularly important as habitat links. The fragmentation of these links and desirable actions and research are discussed in the Regional Hydrological Strategy in Chapter 10.

The establishment of overland habitat links is complicated by the fact that most of the land is privately owned and will therefore require the involvement of landowners. This has already been achieved in certain parts of the region through the activities of LandCare groups and the support of such groups and of individual responsive landowners must be sought.

It is also essential that, in establishing habitat links, strong consideration be given to maintaining adequate strategic fire breaks that provide protection to habitat as well as to human life and property. This can be done to a reasonable degree by avoiding a north-south orientation of the link in particular, meandering the link or planting in discrete clumps of vegetation which are reasonably close to each other but not continuous.

Strategic habitat links are those that connect the most significant and extensive areas where the mutual benefit of the link will achieve the greatest enhancement of fauna, and improve the viability of threatened species. Thirty-seven such links have been identified in NEM and are discussed at the end of chapter 9

Existing habitat links should be protected and maintained. This can be achieved through planning zone or overlay changes, or through greater consideration of environmental values including habitat link values when assessing applications in these areas. This, together with the coordinated management of weeds and vermin and other threatening processes, education of the community and a necessary level of regulation of habitat degrading human activities, will achieve the desired outcome.

Effective coordinated management will require:

- the establishment of regional bodies with representatives from government agencies, municipalities and the community to address widespread threatening processes;
- increased human and financial resource allocation by all the authorities concerned;
- the formation and informed involvement of LandCare, Friends groups and other community based groups;
- strong encouragement and incentives to private landholders to improve their knowledge and understanding of natural habitat on their land and to allocate time to dealing with threats to the long-term viability of resident flora and fauna populations.

This Habitat Link Strategy is provided on the understanding that appropriate steps are taken to protect and enhance existing habitats or sites identified in this report. This can be achieved to a considerable degree by pursuing the conservation measures provided for each of the sites. However, many of the widespread threatening processes identified require a broad scale approach and the coordination of activities of all land managers whether private land holders, government agencies or municipalities. The control of weeds and pest animals in particular will not be achieved unless such an approach is used. The efficient use of human and financial resources also demands this approach.

It is therefore recommended that a comprehensive Regional Conservation Strategy be developed that incorporates the information provided here, but which is further informed by an intensive study of the flora of the region, and which coordinates action at the regional level.

The five major issues identified for the management of indigenous species or stands of indigenous habitat in the study area are:

- 1 habitat destruction, modification or fragmentation;
- 2 population/range declines of rare or threatened species;
- 3 predation by introduced animals and competition or disturbance from introduced and native species;
- 4 Pollution or chemical contamination; and
- 5 human interference and disturbance.

ISSUE 1: Habitat destruction, modification or fragmentation

Habitat values in rural, bushland and urban areas have each been greatly affected by land settlement.

- **rural issues:** farm subdivision and land-use intensification (this includes issues of rock removal, grassland cultivation and land salination on the volcanic plains and tree removal and soil erosion in the foothills);
- **bushland issues:** bushblock subdivision and land-use intensification (this includes issues of wastewater contamination of creeks, earthwork disturbance from dam building, roading, mining and logging, tree removal, companion animal incursions, hobby farm or recreational livestock grazing of significant ground flora areas, weed invasion, bushfires and vehicle and horse rider incursions, firewood collection, shooting and rubbish dumping in public land reserves);
- **urban issues:** residential advance into bushland (this includes issues of weed and vermin invasions, habitat fragmentation, water pollution and disturbance);

Widespread issues across the study area include land clearing/habitat fragmentation and creation of imbalances in natural ecosystems (e.g. elimination of insectivorous birds contributing to leaf defoliation and tree dieback caused by insects), altered fire and hydrological regimes, selective elimination of ground flora species and streamway and wetland degradation by livestock grazing (see Chapter 8).

Studies:

S1.1 River Red Gum insectivorous bird studies. The census plots should be set up as scientific reference points. See chapter 5.

S1.2 Yellow Box insectivorous and migratory bird studies. The census plots should be set up as scientific reference points. See chapter 5.

S1.3 Red Ironbark nectivorous bird studies. The census plots should be set up as scientific reference points. See chapter 5.

S1.4 Instream and wetland biological and water quality studies. See Regional Hydrological Strategy.

Actions

A1.1 Protect existing habitat and habitat links, particularly all stands of threatened habitats, private land stream frontages and public land reserves. This involves implementing native vegetation clearance controls over stands of significant habitat on private land. A set of regional guidelines and controls should be devised to assist planners in considerations of any broad-acre subdivisions. The rock stripping growth industry in grassland on the volcanic plains requires urgent regulation.

A1.2 Implement new planning zones or overlay controls for the protection of indigenous vegetation and substrates in sites of significance. This holds particularly for areas of proposed population or land-use intensification. All areas containing significant stands of River Red Gums in the rural sections of the Merri and Plenty Volcanic Plains should be considered for listing in the proposed River Red Gum Protection Zone. Specific management afforded by the protection controls will be required to maintain long-term vigour and viability of stands of River Red Gums. The most significant of these stands should be considered for nomination as Natural Heritage Areas, with the purpose of attracting external funding to undertake conservation and land protection works. All significant stands of Red Ironbark in the study area should similarly be proposed for listing as Red Ironbark Conservation Areas.

A1.3 Devote increased resources to conservation management. The Department of Natural Resources and Environment, Parks Victoria, and the constituent Councils of NEROC should devote increased financial and human resources to maintaining existing sites of significance and the priority habitat links between these sites.

A1.4 Inform community. This report should be distributed to schools and libraries in the region and promoted throughout the community, to ensure that the community is aware of the information available and how this can be used to the benefit of conservation in the region. Brochures should be

produced summarising the sites of significance, significant species, major threatening processes and conservation measures, and these should be broadly disseminated.

- A1.5 Inform landowners.** Landowners with significant habitat on their land should be advised of this fact, provided with a copy of the relevant section of the report and requested to consider this in the management of their land.
- A1.6 Provide incentives.** Councils should provide incentives such as rate rebates for landowners who appropriately manage natural habitat.
- A1.7 Develop Regional Conservation Strategy.** A coordinated Regional Conservation Strategy should be developed that deals with the protection and enhancement of the natural habitats and flora and fauna of North East Melbourne. This strategy should coordinate the activities of all land managers in addressing major widespread threatening processes and most particularly the control of weeds and vermin. The strategy should incorporate the recommendations made in the Regional Hydrological and Habitat Link Strategies provided in this report. An intensive study of the flora comparable to the level of assessment of the fauna in this report needs to be conducted.
- A1.8 Strengthen habitat links.** Sites of significance proposed as strategic habitat links should receive priority revegetation and land protection works.
- A1.9 Acquire private land and reappraise public land.** Endorse continued non-compulsory acquisition of land for the 'green web parks' including Yarra Valley and Plenty Gorge Parks and re-appraise public land for the proposed Watsons Creek Conservation Link. Recommend the acquisition of the Craigieburn Grassland and O'Herns Road Wetlands sites for incorporation as biological reserves (see Summary).
- A1.10 Prepare land-use and conservation plans for areas of private land of critical biological significance** (i.e. sites of national or very high significance or critical conservation areas).
- A1.11 Prepare land-use and conservation plans for areas of public land of critical biological significance** (i.e. sites of national or very high significance, ecological reference areas or critical conservation areas).
- A1.12 Implement existing Local Conservation Strategies.** Such strategies were developed by the City of Whittlesea, former City of Heidelberg and Shire of Eltham and their implementation should be fully supported by NEROC in its new form. Where appropriate, these strategies should be modified or supplemented with the information provided in this report.
- A1.13 Develop additional Local Conservation Strategies where required.** Adjoining municipalities should also develop such strategies.
- A1.14 Monitor changes in the status of species and habitats.** It is essential to undertake monitoring to determine the effectiveness of management and planning controls. Such monitoring should be undertaken by a variety of groups including NRE, Parks Victoria, municipalities, landowners, and students.
- A1.15 Incorporate fauna and flora field data onto a GIS.**
- A1.16 Establish community conservation and land protection groups.** A network of groups such as those under the NRE LandCare program need to be established to realise the regional conservation strategy objective of long-term enhancement of biological values on private land.
- A1.17 Establish Friends support groups.** Conservation management activities of the smaller public land reserves require urgent upgrading. Groups such as those under the NRE ParkCare program need to be established for all reserves containing regional and higher biological significance to realise the regional conservation strategy objective of long-term enhancement of biological values on public land.
- A1.18 Enlist other organisations, initiatives and programs.** Active groups and programs involved with conservation and land protection works in Greater Melbourne include Greening Australia, Land for Wildlife, Trust for Nature (Victoria) and Australian Trust for Conservation Volunteers.

A1.19 Environmental impact assessments. Proposals for development or large-scale earth-works (e.g. quarries) with the potential to eliminate or affect indigenous vegetation or wildlife in sites of state or higher biological significance must be accompanied by a full EIA. These must also address the effects on adjoining land, habitat links and the catchment hydrological cycle.

A1.20 Exclude livestock grazing from highly significant or sensitive areas (e.g. stands of River Red Gum, streamways and erosion-prone gullies) to facilitate natural regeneration and land protection.

A1.21 Restore natural hydrological cycles to streams and wetlands. In accordance with the Regional Hydrological Strategy.

A1.22 Linear reserve management. Replace antagonistic management (e.g. weedicide spraying and grading of railway reserve grasslands or mowing of aqueduct reserves) with practices favourable for maintaining conservation values. Identify and protect indigenous roadside vegetation areas, particularly those on closed roads.

ISSUE 2: Population/range declines of rare or threatened species

Studies

S2.1 Specific surveys and population recovery plans for the most threatened species (e.g. Southern Lined Earless Dragon, Small Ant-blue butterfly and Charming Spider-orchid). Studies on orchid species in the study area have included: fire ecology and ecological burning trials; natural pollination and hand pollination trials; annual counts and direct measures of mortality factors and reproductive success; seed collection and germination trials; construction of fenced enclosures for protection from herbivores; and weed and vermin control. Several butterfly species are in need of similar intensive research.

S2.2 Preparation of conservation management plans and, where applicable, critical habitat determinations for threatened species, or environmental impact statements in areas where development proposals (e.g. housing, mining, etc.) are likely to be detrimental.

S2.3 Surveys for biotic groups on which there is incomplete distributional/ecological knowledge (e.g. plants, fish and invertebrates).

Actions

A2.1 Restoration of habitat links. Commence land management practices favourable for maintaining conservation values.

A2.2 Threatened species management on public lands. Upgrade levels of conservation management on all public lands. Implement management practices favourable for maintaining conservation values. The road frontages of most reserves in the study area form the principal areas for weed invasion (e.g. Large Quaking-grass and Montpellier Broom). Roadside conservation management requires substantial upgrading. (See Roadside conservation strategy in site 15). Review public land disposal programs and retain areas containing significant or threatened biological values.

A2.3 Establishment of community conservation and land protection groups.

A2.4 Establishment of friends support groups.

ISSUE 3: Predation by introduced animals and competition or disturbance from introduced and native species

Studies

S3.1 Surveys and monitoring of vermin and environmental weed populations.

Actions

A3.1 Companion animal restraints within and near sites of high biological significance (particularly in developing urban areas). The issue of wandering cats and dogs needs to be uniformly addressed throughout the study area.

A3.2 Develop Regional Pest Animal Control Program. The control of pest animals requires a catchment or regional approach. Efforts at control of rabbits, foxes, feral cats and dogs, and other introduced animals are spasmodic and uncoordinated. Extensive effort by particular land managers is countered by the reinvasion of animals from surrounding untreated areas. Only short-term gains are being achieved. It is essential that land managers coordinate their efforts. Target introduced predators include the fox, feral cat, feral dog, Brown Trout, Roach and Mosquito Fish. Target introduced competitors include the rabbit, feral goat, Black Rat, Common Myna, Blackbird, Common Starling, Brown Trout, Roach, European Carp, Goldfish, Mosquito Fish, Honey-bee and European Wasp.

A3.3 Monitoring and, if necessary, culling programs of problem native species across the study area. Ecological imbalances due to settlement and habitat fragmentation can cause population increases of native fauna. Problem species in the study area include the Bell Miner, Noisy Miner, Common Brushtail Possum, Eastern Grey Kangaroo and White-winged Chough. Native vegetation or populations of other fauna species, particular when in refugias, can be detrimentally affected by large concentrations of these species. The causes and effects need full assessment.

A3.4 Develop Regional Pest Plant Control Program. As with pest animals, control of pest plants requires a coordinated effort if effective, cost efficient control is to be achieved. The development of local laws controlling the sale and propagation of serious environmental weeds (as was initiated by the former Shire of Eltham) should be pursued across all municipalities. Species that authorities and land owners are expending time, money and effort to remove are being planted by others unaware of (or unconcerned about) their invasive properties.

A3.5 Public education and interpretation of conservation values. There is a particular need to target high density living areas where there are untapped labour forces and potential for exposure to conservation issues and areas of bushland and farmland in sparsely settled areas where relatively intact biological values persist. The issues of unauthorised horse and trail-bike riding and off-road vehicles in public land areas of significant bushland need to be addressed. The impact of active or intensive recreational activities on biologically significant areas (particularly streamways) needs to be regulated.

ISSUE 4: Pollution or chemical contamination

Studies

S4.1 See Regional Hydrological Strategy.

Actions

A4.1 Identification and control of pollution point sources. In accordance with the Regional Hydrological Strategy.

A4.2 Wastes strategy. A comprehensive review is recommended on waste generation and disposal and the type and location of tip-sites in the study area. Historically, valley land-fill sites in the hills have been sociologically controversial and have received strong local community opposition. They are also ecologically unsound due to leachate entry into local drainage systems. Quarry sites on the plains are equally contentious in that most, and particularly those containing water, are biologically significant. Most are located within a few hundred metres of streams. The nature of sub-surface water movement on the plains enables the direct entry of leachate into streams. Primary sewage treatment plants such as those operating along sections of the Plenty River and Merri Creek are ecologically unsound (see Regional Hydrological Strategy).

ISSUE 5: Human interference and disturbance

Actions

A5.1 Confidentiality and protection of locations of threatened species. This particularly relates to orchids, butterflies, cave-bats, reptiles and the Freshwater Blackfish. The security gating of all mines in the study area known to support (or potentially supporting) cave-bats is an urgent priority. Unauthorised collection of orchids and butterflies must be controlled. Waters in streams known to support significant populations of blackfish should be considered for closure to angling.

A5.2 Service infrastructures. Disturbance and habitat loss from these is substantial and increasing across the study area. A rationalisation of future installations is required. Where conflicts with conservation values arise, measures to reduce the levels of impact, particularly with follow-up management, are essential. Areas include Gas and Fuel pipeline and SEC transmission line easements, roadside phone, power and cable TV lines and water mains and pipelines.

A5.3 Implementation of traffic speed restrictions in strategic faunal crossing points or corridors in rural and bushland areas to curb the rate of road-killed wildlife. The provision of safe passage such as under-road tunnels is considered necessary in several areas (particularly in the Yarra Valley).

STRATEGIC HABITAT LINKS

There are four types of habitat links in NEM (Map 3). Two shown as arrows are based on existing links. These include fully functional strategic habitat links (double arrow) and partially functional habitat links (single arrow). The other two types shown as unbroken lines are the network of links required under implementation of the Regional Habitat Link Strategy. These include a higher priority regional link network and lower priority district link network.

There are two types of habitat links—actual and potential. The first is for areas of existing contiguous habitat connecting sites of significance which are known or likely to perform as faunal corridors. These include overland links, creeks and roadsides. The second is areas with potential as habitat links through indigenous revegetation. These include transmission line, rail and aqueduct reserves and other linear open space utilities.

Strategic habitat links (SHLs) form a functional system of interconnecting wildlife corridors. These include sections of the Yarra River and its major tributaries (Plenty River, Merri Creek, Diamond Creek and Watsons Creek) and cross catchment links including Long Gully Creek and the mountains of the Great Dividing Range. These are critical to the maintenance of faunal/habitat significance at the regional level.

There are thirty-seven sites of significance in NEM proposed as SHLs. for NEM (Map 3).

The development of systematic and integrated programs to protect, manage and enhance these links (which have been fragmented by land settlement) may be essential to reduce the risk of sites of significance becoming 'wildlife isolates'. The continued viability of fauna and biological significance of sites is dependent on faunal movement through connecting SHLs. Revegetation and habitat protection would enhance the significance of sites within the link. Preservation and enhancement of SHLs is the key recommendation of the Regional Habitat Link Strategy.

SHLs are:

- The key site/series of sites within a particular biophysical zone or major catchment that are presently or potentially the most critical or important for fauna movement. The maintenance or establishment of effective habitat links is considered essential for continued viability of faunal populations.
- The only or most contiguous habitat link between two or more biophysical zones or major catchments. These links form some of the most important faunal corridors in NEM and are considered critical in the regional network of habitat links.
- The most intact and contiguous habitat link (generally riparian) between geographically separated biophysical types (e.g. ranges and lowland hills).
- Critical to population viability within threatened habitat types in NEM.
- The key habitat link in need of restoration and protection between the most significant sites within a biophysical region. These are considered critical for the connectivity of highly significant faunal populations and the viability of these in the long-term.

The latter category has two purposes. To highlight the importance of the site as a link and to highlight the need for urgent enhancement of the link. Re-establishment of these links is considered critical to maintaining faunal values of the connecting sites.

Habitat links are connecting areas of native vegetation critical for movements and continued viability of faunal populations. They are utilised by a diverse assemblage of faunal species. Habitats throughout the lowlands of Greater Melbourne have been modified and degraded since European settlement and many have been reduced to isolated stands. Habitat links in settled areas have been fragmented by clearing for farmland and housing. This has made management, particularly maintenance of species population viability, difficult to effect. The effectiveness of habitat links for ground fauna in these areas is low and has led to local population extinctions. Remaining links are crucial for survival of forest dependent mammals and reptiles, butterflies and migratory birds. Protection of habitat links is essential to counter the adverse effects of habitat fragmentation.

Species populations must be of sufficient size to remain viable in the long term. Habitat links need to be broad and diverse to achieve this. Areas they connect require adequate size and buffering from external

disturbances. Shortfalls in any of these need to be countered by increased conservation management. When not met, extinctions in the short term are usually of species intolerant to environmental disturbance or those that have evolved intricate ecological and environmental relationships (e.g. ants with butterflies, pollinating insects with orchids). In the long term, extinctions may widen to the regional level and, ultimately, to habitats and faunal assemblages.

Several important biological imbalances affecting the long-term viability of fauna and flora populations in NEM have arisen from land clearing disturbing or fragmenting habitat and severing habitat links. These centre around the issue of management of refugial habitats. Reference should be made to detailed discussions of the issue in sites of the alluvial plains (Volume 3) and lowland hills (Volume 4). Native species that have benefited include the Bell Miner and Eastern Grey Kangaroo. Under increasing pressure from recreational land-use and subdivision in surrounding areas, these imbalances will increase unless adequate conservation measures are undertaken to correct them.

The key requirement within the regional habitat link strategy is to strengthen all habitat links. This is particularly important at bottlenecks (e.g. towns such as Mernda along Plenty River and Eltham along Diamond Creek) and radial links across catchments. Lowland radial links near developing urban areas are becoming highly fragmented and require protection and intensive conservation management to continue to function.

Maintaining biological attributes in sites will require the protection of strategic habitat links and prevention of further fragmentation of natural habitat. Of equal importance is the enhancement of external habitat links by revegetation. Conservation programs to provide for replanting and natural regeneration will need to be implemented to reduce the risk of local populations becoming isolated.

For links to remain effective, they require significant stands of bushland to be protected from livestock grazing. Weed, erosion and vermin control is also needed. Revegetation of cleared or degraded discontinuities in links would provide greater connectivity between isolated stands of bushland elsewhere in the district. In the lowlands these links are mostly contained on private land. Assistance should be provided to property owners within the links to undertake these activities.

Suggested operative conditions for Strategic Habitat Links include:

- management for enhancement or restoration of connectivity through the implementation of programs to provide for protection, replanting and natural regeneration (e.g. streamways). The support and cooperation of government agencies, councils and landowner groups and the development of a private land habitat protection incentive scheme (e.g. assistance with fencing costs) is essential;
- conservation and planning controls that preserve biological attributes of habitat links and consolidate existing and potential occurrences of these attributes under prescribed management;
- full address of impact on habitat connectivity during planning considerations for any development proposal which could compromise habitat or environmental quality.

Yarra –Kinglake Ranges Nature Conservation Link

Parks Victoria and the Open Space 2000 initiative are developing an open space/green web network from the bay to the ranges. This is primarily along Melbourne's arterial river and radial drainage systems where the main open space network exists. The Yarra supports the most natural and contiguous areas of native vegetation and functional faunal corridors in urban Melbourne. A primary purpose of the initiative is to link existing open space in the system to protect and enhance conservation values in areas which are becoming increasingly fragmented by urban growth and development. This maximises their environmental, recreational and educational potential. The open space strategy recognises the importance of streamway rehabilitation and the preservation of natural values of the Yarra Valley.

The contiguous stand of riparian forest along the Yarra River and Watsons Creek provides the most effective habitat link between the lowlands and the Great Dividing Range in Greater Melbourne. The faunal corridor is crucial in the movements of forest species from the Kinglake Ranges to the Yarra. All other tributary links in the Lower and Middle Yarra have been severed by past land clearing or are becoming fragmented by urban development. The long-term viability of populations of animals in inner sections of the link is dependent on protecting outer sections.

The Watsons Creek section of the nature conservation link needs to be sufficiently wide to support resident populations of animals as well as facilitate the movement of animals between more substantial areas of habitat along the Yarra and in Kinglake NP. The primary objective of management should be to enhance the habitat link for the movement of wildlife and improve the quality of habitat for its resident species. This would be best achieved through protection of significant stands of habitat and restoration of degraded habitat along the streamway.

Species which are most dependent on the nature conservation link include birds requiring large trees or tree hollows for nesting, including parrots and birds of prey; small forest birds, particularly honeyeaters; migratory songbirds (insectivores); shrub layer species such as fantails and whistlers; arboreal mammals including bats; and most particularly, mobile species such as Koalas. Other dependent species include ground fauna, most particularly reptiles and small to medium size mammals (Platypus and Long-nosed Bandicoot) and freshwater fish. Improved protection of streamway vegetation would greatly assist the conservation of these species.

The Yarra–Kinglake nature conservation link has been recognised by the Land Conservation Council of Victoria. This body formulates the establishment and mode of conservation management for parks and public land areas. Guidelines for management of the conservation link include the conservation and protection of species or communities of indigenous animals and plants and provision for educational and scientific study and management practices which enhance the link.

The Yarra–Kinglake Ranges biological reserve system is one of few in Victoria that link wet mountain forests through herb-rich foothill forest and box–stringybark woodland to lowland grassy and floodplain riparian woodlands. A biological reserve system containing this diversity and rarity of habitat types and range in flora and fauna is unique in Victoria. The proximity and utility of this park to a metropolis adds to its significance as a Natural Heritage Area.

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VOLUME 2

VOLCANIC PLAINS

Merri Upland Volcanic Plains (MUVP)

MUVP A. Merri Creek Beveridge to Wallan

- Site 1. Beveridge Rail Reserve–Camoola Swamp
- Site 2. Hernes Swamp
- Site 3. Spring Street Swamp Beveridge

MUVP B. Merri Creek Donnybrook to Beveridge

- Site 4. Bald Hill
- Site 5. Kalkallo– Donnybrook North Rail Reserve

Merri Lowland Volcanic Plains (MLVP)

MLVP A. Merri Creek Clifton Hill to Campbellfield

- Site 6. Heidelberg Road to Normanby Avenue
- Site 7. McBryde Street–Central Creek–Edwardes Lake Park

MLVP B. Merri Creek Campbellfield

- Site 8. Barry Road Gorge
- Site 9. Cooper Street

MLVP C. Merri Creek Craigieburn to Donnybrook

- Site 10. Craigieburn Grassland
- Site 11. Craigieburn to Donnybrook
- Site 12. O’Herns Road Wetlands

MLVP D. Wollert–Edgars Creek Headwaters

- Site 13. Edgars Creek Headwaters
- Site 14. Summerhill Road

Plenty Lowland Volcanic Plains (PLVP)

PLVP A. Darebin and Barber Creeks

- Site 15. Fenwick and Surrounds
- Site 16. Plenty River Mernda
- Site 17. Silver Gum Park Woodstock

PLVP B. Epping–South Morang

- Site 18. Epping to Wollert
- Site 19. Mill Park–Blossom Park
- Site 20. Quarry Hill

PLVP C. Darebin Creek Darebin to Bundoora

- Site 21. BMG Quarry–Howy’s
- Site 22. Bundoora Park
- Site 23. Dougharty Road to Plenty Road
- Site 24. Darebin Parklands

HABITATS of the Volcanic Plains

5.3. Riparian Forest—creek

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 2^a

Distribution: restricted in MUVPA, where degraded

Landforms: foothill—creeks of 6–9 months flow

Canopy: Manna Gum; with Yellow Box; 20–30 m tall and 20–30% cover

11.2. Box–Stringybark Woodland—hill-crest

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 16^a, 20^{ab}

Distribution: restricted in PLVP (Quarry Hill and head of the Plenty Gorge south of Mernda) and formerly localised at sandstone outcrops in MUVPA and MLVP (e.g. Woody Hill at Donnybrook and Summer Hill at Craigieburn)

Landforms: foothill—exposed hill-slopes, hill-crests and river spurs (Silurian sandstone); fragmented and degraded

Canopy: Yellow Box–Red Stringybark; with Long-leaf Box, Grey Box (eliminated), Candlebark and Hill Manna Gum (dominant at Quarry Hill); 10–15 m tall and 20–30% cover

14.1. Grassy Woodland—volcanic plain

Conservation status: regionally threatened

Reference stands: 15^{ad}

Relatively intact and extensive stands: 13^b, 14^a, 22^a

Partially intact or small stands: 4^a, 9^a, 11^a, 13^a, 15^{bce}, 17^a, 18^d, 19^c, 21^a

Remnant, degraded or establishing stands: 4^b, 5^{bd}, 8^a, 10^{cd}, 11^b, 12^a, 16^a, 18^{abc}, 19^{ab}, 20^b, 23^a, 24^a

Distribution: widespread in PLVP and restricted in MUVPA and MLVP

Landforms: Quaternary volcanic stony and gilgai plains with a small occurrence on Tertiary volcanic cappings at RMIT Bundoora

Canopy: River Red Gum; with Yellow Box (rare) and Swamp Gum (uncommon in seasonally waterlogged situations such as stony knoll swales and at springs); 12–15 m tall and 10–20% cover (often thinned to <10% cover)

14.2. Grassy Woodland—volcanic capping/cone

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 1^a, 4^a

Distribution: restricted in MUVPA/B where eliminated

Landforms: Quaternary volcanic cone-slopes

Canopy: Yellow Box–Hill Manna Gum; with Long-leaf Box; 12–15 m tall and 15–25% cover

14.3. Grassy Woodland—alluvial plain

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 20^a

Remnant, degraded or establishing stands: 7^b, 16^a, 20^b, 21^a, 22^a, 24^a

Distribution: restricted in MLVP A/B (Edwardes Lake Park, Coburg, Fawkner and Campbellfield), PLVP (Plenty River, flanking north-east side of Quarry Hill and Darebin Parklands on Ivanhoe side)

Landforms: foothill—plain-slopes (Quarry Hill and Ivanhoe). Coastal plain—Tertiary marine sand-crests (Fawkner and Coburg). Alluvial plain—Tertiary lake alluvium sand-plain (Fawkner to Campbellfield) and river alluvium sand-plain (Bundoora Park and RMIT Bundoora)

Canopy: River Red Gum; with Yellow Box; 15–20 m tall and 10–25% cover

14.6. Grassy Woodland—valley

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 20^b

Distribution: localised at Quarry Hill (PLVP B) where highly fragmented and degraded

Landforms: foothill—broad valleys

Canopy: Yellow Box–Candlebark; with Long-leaf Box and Red Stringybark; 15–20 m tall and 20–30% cover

14.8. Grassy Woodland

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 8^a

Distribution: eliminated from MLVP apart from a remnant stand at Scots Church Campbellfield

Landforms: Quaternary volcanic buckshot crests

Canopy: Grey Box; with Yellow Box; 10–20 m tall and 10–20% cover; joined by Buloke (*Allocasuarina luehmannii*) west of Melbourne

Shrubs: Golden Wattle, Lightwood, Sweet Bursaria, Wedge-leaf Hop-bush, Gold-dust Wattle and Small-leaf Eutaxia

Herbs: wallaby-grasses and spear-grasses

Description: the stand at Scots Church is very significant in the context of NEM as it represents the only representative containing understorey shrubs of a formerly more widespread habitat; this has been eliminated by urban and rural land settlement and Grey Box was selectively removed for firewood and posts; the 600–620 mm annual rainfall isohyet between Craigieburn and Wollert represents the high rainfall eastern limit of this sub-community in GM

16.3. Floodplain Riparian Woodland—stream terrace

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: nil

Remnant, degraded or establishing stands: 24^a

Distribution: restricted in PLVP

Landforms: creek terraces (Darebin Creek)

Canopy: River Red Gum; 15–20 m tall and 10–20% cover

16.4. Floodplain Riparian Woodland—riverbank

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 16^a

Distribution: restricted in PLVP A

Landforms: riverbanks (Plenty River)

Canopy: **Manna Gum**; 15–20 m tall and 10–20% cover

16.5. Floodplain Riparian Woodland—stream terrace

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 16^a

Distribution: restricted in PLVP A

Landforms: river terraces (Plenty River)

Canopy: **Manna Gum**; with Long-leaf Box and Yellow Box; 15 m tall and 15–20% cover

16.6. Floodplain Riparian Woodland—creek

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Remnant, degraded or establishing stands: MUVB B 24^a

Distribution: restricted in MUVB B (Merri Creek upstream of Merriang Park) and PLVP C (Darebin Parklands)

Landforms: creeks (sedimentary sections of the Merri and Darebin Creek) of 9–12 months flow

Canopy: **River Red Gum**; with Swamp Gum and Manna Gum; 15 m tall and 10–20% cover (tree/shrub strata mostly cleared)

18.2. Riparian Scrub—volcanic stream

Conservation status: regionally threatened

Reference stands: 9^a, 10^{abd}, 11^a

Relatively intact and extensive stands: 4^a, 8^a

Partially intact or small stands: 5^{cd}, 6^{ab}, 7^{ac}, 16^a

Remnant, degraded or establishing stands: 23^a, 24^a

Distribution: restricted in MUVB and MLVP (Merri Creek) and localised in PLVP (Plenty River at Mernda and remnant along the lower and middle Darebin Creek)

Landforms: Quaternary volcanic streams of 9–12 months flow

Canopy: **Woolly Tea-tree**; with Large Bindweed, Silver Wattle, Hemp Bush, River Red Gum (emergent) and Tree Violet with the alien Hawthorn, Gorse, Sweet Briar, Blackberry, White Crack Willow (Plenty/lower Darebin) and African Box-thorn; 5–8 m tall and 30–50% cover

Instream submerged/floating herbfield: Water-ribbons, Swamp Club-sedge, Blunt Pondweed and Lake Milfoil

Creebank/terrace emergent herbfield: Water Plantain, Bare Twig-sedge, Salt Club-sedge, Marsh Club-sedge, Common Spike-sedge, Knobby Club-sedge, Flat-fruit Club-sedge, River Club-sedge, Hollow Rush, Common Tussock-grass, Common Reed, Lesser Joyweed, Sea Celery, Australian Lilaepsis, Shield Pennywort, Creeping Cotula, Water Buttons, Hastate Orache, Swamp Crassula, Shiny Swamp-mat, River Mint, Slender Knotweed, Mud Dock and Bidgee-widgee; alien weeds include Jointed Rush, Cocksfoot, Toowoomba Canary-grass, Water Couch and

Cleavers (Three-cornered Garlic, Wandering Jew, Blue Periwinkle and Creeping Buttercup on the Plenty/lower Darebin)

20.4. Cliff/Escarpment Shrubland—exposed sedimentary

Conservation status: regionally disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 16^a, 24^a

Remnant, degraded or establishing stands: 8^a, 11^a

Distribution: localised in MLVP B (Barry Road gorge of the Merri Creek), PLVP A (Plenty River downstream of Mernda) and PLVP C (Ivanhoe side at Darebin Parklands)

Landforms: exposed sedimentary stream cliffs

Canopy: Golden Wattle; with Lightwood, Black Wattle and Wedge-leaf Hop-bush; scattered emergent Yellow Box (Yellow Gum eliminated); 2–5 m tall and 20% cover

20.5. Cliff/Escarpment Shrubland—volcanic

Conservation status: regionally threatened

Reference stands: nil

Relatively intact and extensive stands: 10^{ab}, 11^a

Partially intact or small stands: 4^a, 6^b, 8^a, 9^a, 10^d, 16^a, 18^c

Remnant, degraded or establishing stands: 5^{cd}, 6^a, 7^{ac}, 15^b, 18^{bd}, 19^a, 21^a, 22^a, 23^a, 24^a

Distribution: restricted in MUVP, MLVP and PLVP; fragmented and degraded apart from Craigieburn Grassland

Landforms: Quaternary volcanic cliffs and cones

Canopy: Lightwood–Tree Violet; with Drooping Sheoke, Black Wattle, Blackwood, River Red Gum (emergent), Tree Bursaria, Small-leaved Clematis and Small-leaf Bramble and the alien Fennel, Hawthorn, Gorse, Sweet Briar and African Box-thorn; 2–8 m tall and 20–30% cover; species including the Tree Banksia have been eliminated while River Red Gum has been cleared from the cliffs on the Merri Creek

22.1. Stony Knoll Grassland

Conservation status: regionally threatened

Reference stands: 10^{abc}

Relatively intact and extensive stands: 4^a, 10^d, 14^{ab}, 15^{bd}

Partially intact or small stands: 1^a, 2^b, 4^b, 5^b, 8^a, 9^a, 11^a, 12^a, 13^b, 15^{ace}, 18^{abcd}

Remnant, degraded or establishing stands: 3^a, 5^{acd}, 7^a, 13^a, 16^a, 17^a, 19^{bc}, 21^a, 23^a

Distribution: widespread in MUVP and MLVP; restricted in PLVP

Landforms: Quaternary volcanic stony crests and stony rises

Character species: Kangaroo Grass; with Yellow Rush-lily, Weeping Grass, Short Wallaby-grass, Slender Spear-grass, Wattle Mat-rush, Scaly Buttons, Blushing Bindweed, Australian Stonecrop, Common Woodruff, Grassland Crane's-bill, Creeping Bossiaea, Small-leaf Bramble and emergent Tree Violet, Lightwood, Blackwood, Hedge Wattle and Tree Bursaria

Description: 0.5 m tall and 40–60% cover; sub-community complex with native grassland of varying quality, often with degraded sections dominated by alien herbs and shrubs such as Hawthorn, Gorse or Sweet Briar; at the time of settlement shrubs in common with 20.5 would have been more prominent and the community would be more correctly termed stony knoll shrubland

23.1. Plains Grassland

Conservation status: regionally threatened

Reference stands: 10^{ab}, 14^b

Relatively intact and extensive stands: 4^a, 10^{cd}, 14^a

Partially intact or small stands: 1^a, 2^b, 5^{acd}, 7^a, 9^a, 12^a, 13^b, 15^b, 18^{bc}

Remnant, degraded or establishing stands: 3^a, 4^b, 5^b, 13^a, 15^{acd}, 18^a

Distribution: restricted in MUVP and the northern section of MLVP; localised in PLVP

Landforms: Quaternary volcanic stony plains (particularly plain-slopes and cone-slopes in drainage line catchment headwaters), creek and ephemeral drainage line terraces/floodplains and freshwater meadows fringing seasonal wetland in lava blockage swamps and stony knoll apron swales

Character species: **Common Tussock-grass**; with Common Sedge, Common Bog-sedge, Common Wheat-grass, Weeping Grass, Brown-back Wallaby-grass, Common Wallaby-grass, Striped Wallaby-grass, Kangaroo Grass, Grassland Crane's-bill, Grassland Wood-sorrel, Common Woodruff and Slender Speedwell

Description: 0.5–1 m tall and 40–80% cover; 23.1 is native grassland of varying quality from ungrazed species-rich remnants to degraded creek terraces and seasonal wetlands invaded by pasture weeds, particularly Yorkshire Fog, rye-grasses, Toowoomba Canary-grass and Chilean Needle-grass and legumes; often cultivated as surface rock is generally absent; diverse sub-community complex of seasonally damp areas; shares ecotones with creeks (24.1, 30.1), swamps (25.2), stony knoll apron swales (25.3) and drier grasslands (22.1 and 23.2); rare grazing sensitive grassland herbs such as the Tough Scurf-pea and Dusky Scurf-pea grow amongst the poa tussocks

23.2. Plains Grassland

Conservation status: regionally threatened

Reference stands: 5^b, 9^a

Relatively intact and extensive stands: 4^a, 8^a, 10^{abcd}, 15^{abd}

Partially intact or small stands: 1^a, 2^b, 4^b, 5^{acd}, 11^a, 13^{ab}, 14^{ab}, 15^{ce}, 18^c

Remnant, degraded or establishing stands: 12^a, 17^a, 18^{ab}

Distribution: widespread in MUVP and MLVP; restricted in PLVP

Landforms: Quaternary volcanic stony plains, gilgai plains and silt plains

Character species: **Kangaroo Grass or (wallaby-grasses in grazing land)**; with Common Bog-sedge, Yellow Rush-lily, Blown Grass (*Agrostis aemula*), Common Blown Grass, Long-hair Plume-grass, Weeping Grass, Velvet Tussock-grass, Five-awned Spear-grass, Common Wallaby-grass, Short Wallaby-grass, Brown-back Wallaby-grass, Bristly Wallaby-grass, Wattle Mat-rush, Scaly Buttons, Grassy Bindweed, Grassland Wood-sorrel, Sheep's Burr, Common Woodruff and Slender Speedwell

Description: 0.5–1 m tall and varying from dense cover (40–80%) of Kangaroo Grass to open cover (10–20%) grazing land of wallaby-grasses; 23.2 is native grassland of varying quality with degraded sections invaded by pasture weeds and sometimes cultivated on the silt plains where surface rock is absent; it is a sub-community complex reflecting variations in soil and landform types and site wetness, as modified by land-use practices; it occupies drier situations than 23.1 ranging from treeless grassland to the understorey of River Red Gum grassy woodland (14.1); and shares ecotones with 25.3 when adjoining seasonally wet gilgais and damp flats on silt plains

24.1. Drainage Line Herbfield

Conservation status: regionally threatened

Reference stands: 10^{ab}

Relatively intact and extensive stands: 10^d, 14^{ab}

Partially intact or small stands: 13^b, 15^b

Remnant, degraded or establishing stands: 18^c

Distribution: restricted in MLVP C/D (notably Summer Hill Drainage Line at Craigieburn Grassland) and PLVP A/B; localised in MUVB

Landforms: Quaternary volcanic drainage lines (3–6 months flow); black clays that are plastic when wet and cracking when dry

Character species: **Common Spike-sedge;** with Fine Twig-sedge, Common Sedge, Curly Sedge, Nodding Club-sedge, Common Bog-sedge, Streaked Arrow-grass, Common Blown Grass, Australian Salt-grass, Common Tussock-grass (fringing on terraces), Creeping Cotula, Salt Pratia, Strawberry Clover (alien), Shiny Swamp-mat and Grassland Wood-sorrel

Description: sub-community complex with brackish flora components; pools containing River Club-sedge, Water-ribbons and sporadic River Red Gum and Tree Violet provide affinity with 30.1 (tree/shrub strata mostly cleared); 0.2–1 m tall and 40–60% cover

25.1. Seasonal Wetland—freshwater meadow/alluvial plain

Conservation status: regionally disjunct

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 20^a

Distribution: eliminated from PLVP B (Mernda swamp)

Landforms: shallow freshwater marsh (now drained and with several dams)

Character species: **Rush Sedge–Common Spike-sedge–Austral Rush;** with Common Sedge, Slender Spike-sedge, Veined Swamp Wallaby-grass, Common Tussock-grass, Waterwort, Slender Knotweed, White Purslane and River Buttercup; 0.5–1 m tall and 40–60%

25.2. Seasonal Wetland—grassy/volcanic plain

Conservation status: regionally threatened

Reference stands: 2^b

Relatively intact and extensive stands: 12^a, 14^a

Remnant, degraded or establishing stands: 15^{bd}, 18^c

Distribution: localised in MLVP and MUVB; eliminated from PLVP

Landforms: ephemeral swamps (inundated 3–6 months a year) associated with lava blockage depressions

Character species: **Common Tussock-grass–Rush Sedge;** with Common Sedge, Common Spike-sedge, Small Spike-sedge, Grassy Club-sedge, Yellow Rush, Common Blown Grass, Veined Swamp Wallaby-grass, Australian Sweet-grass, Mat Grass, Five-awned Spear-grass, Brown-back Wallaby-grass, Lesser Joyweed, Prickfoot, Milky Beauty-heads, Common Sneezeweed, Swamp Crassula, Waterwort and Varied Raspwort

Description: 0.5–1 m tall and 40–60% cover; low rainfall volcanic variant of 25.1; the combined effects of draining, livestock grazing and possibly salination has reduced Rush Sedge to minor occurrences

25.3. Seasonal Wetland—gilgai/swale

Conservation status: regionally threatened

Reference stands: 5^b, 10^{abc}

Relatively intact and extensive stands: 4^a, 9^a, 10^d, 14^{ab}

Partially intact or small stands: 1^a, 2^b, 4^b, 5^{acd}, 8^a, 11^a, 13^b, 15^{ab}, 18^b, 22^a

Remnant, degraded or establishing stands: 12^a, 15^{cde}, 16^a, 17^a, 18^{acd}, 19^b, 21^a

Distribution: restricted in MUVP and MLVP (eliminated from MLVP A); localised in PLVP

Landforms: stony knoll apron swales, gilgais, damp flats on silt plains, drainage lines and lava blockage swamps and depressions

Character species: Brown-back Wallaby-grass; with Common Spike-sedge, Small Spike-sedge, Floating Club-sedge, Grassy Club-sedge, Common Bog-sedge, Toad Rush, Yellow Rush, Finger Rush, Common Blown Grass, Blown Grass (*Agrostis aemula* var. *setifolia*), Common Love-grass, Common Tussock-grass, Prickfoot, Milky Beauty-heads, Poison Lobelia, Grassy Bindweed, Small Loosestrife and Woodruff (*Asperula* aff. *wimmerana*)

Description: 0.1–0.5 m tall and 40–60% cover; gilgai occurrences are small (few m²) and have a frequent matrix pattern within Kangaroo Grass plains grassland (23.2; also silt plains); lava blockage swamps also display gilgai topography (associating with 25.2); stony knoll apron swale occurrences are larger and associate with Common Tussock-grass plains grassland (23.1); the sub-community has been previously included under plains grassland; the variant at stony knoll apron swales has been described as Stony Knoll Wetland (Ecology Australia 1996)

25.5. Seasonal Wetland—floodplain herbfield

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 3^a

Remnant, degraded or establishing stands: 1^a, 2^b

Distribution: localised in MUVP A

Landforms: floodplain swamps

Character species: Common Tussock-grass–Tall Sedge; with Common Sedge, Common Spike-sedge, Joint-leaf Rush, Streaked Arrow-grass, Veined Swamp Wallaby-grass, Australian Sweet-grass, Common Reed, Swamp Crassula, Waterwort, Varied Raspwort, Upright Milfoil, Small Loosestrife, Robust Willow-herb, Slender Knotweed; emergent Woolly Tea-tree at Spring Street Beveridge, 0.2–2 m tall and 60–80% cover

25.7. Seasonal Wetland—emergent herbfield

Conservation status: regionally secure

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 7^b, 12^a, 15^b, 19^b, 21^a, 22^a, 23^a, 24^a

Remnant, degraded or establishing stands: 1^a, 2^b, 3^a, 4^a, 15^e, 17^a, 18^a

Distribution: restricted in MUV, MLVP and PLVP

Landforms: deep and shallow freshwater marshes at artificial waterbodies (dams, culverts and drainage channels; natural occurrences drained or deepened)

Character species: Common Reed–Cumbungi–Tall Spike-sedge; with Water Plantain, Common Spike-sedge, River Club-sedge, Jointed Rush (alien), Joint-leaf Rush, Water Couch (alien), Floating Pondweed, Water-ribbons, Lesser Joyweed, Water Buttons, Water Starwort (alien), Swamp Crassula, Waterwort, Upright Milfoil, Slender Knotweed and Curled Dock (alien); 0.5–3 m tall and 60–80% cover

25.8. Seasonal Wetland—brackish meadow

Conservation status: regionally threatened/disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 10^a

Distribution: disjunct in MLVP C (north-eastern Craigieburn Grassland)

Landforms: dry surface lake land-locked by lava flows; the salinity is likely due to a combination of underground springs and surface evaporation

Character species: Common Blown Grass; with Common Spike-sedge, Small Spike-sedge, Sea Barley-grass (alien), Brown-back Wallaby-grass, Nodding Club-sedge, Annual Celery, Plains Buttercup, Buck's-horn Plantain (alien) and Creeping Monkey-flower; 0.1–0.5 m tall and 30–50% cover; only occurrence in NEM; brackish flora components have affinity with 24.1

26.1. Permanent Wetland—submerged/floating herbfield

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 12^a

Partially intact or small stands: 7^b, 15^b

Remnant, degraded or establishing stands: 17^a, 19^b, 23^a, 24^a

Distribution: restricted in MUV, MLVP and PLVP

Landforms: deep and shallow freshwater marshes at artificial waterbodies (quarries and dams)

Character species: Blunt Pondweed; with Pacific Azolla, Common Duckweed and Fennel Pondweed; 10-50% cover

27.1. Swampy Woodland—floodplain

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 1^a, 2^{ab}, 3^a, 5^a

Distribution: formerly restricted in MUV A/B

Landforms: seasonally waterlogged stream and swamp deposits on the floodplain of the Merri Creek upstream of Merriang Park

Canopy: Swamp Gum; with Blackwood, Yellow Box, Candlebark and Narrow-leaf Peppermint (tree/shrub strata eliminated); 10–15 m tall and 10–20% cover

28.1. Swampy Riparian Woodland—creek

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: MUVP A/B

Distribution: restricted in MUVP A/B where reduced to remnant strata

Landforms: creek (Merri Creek upstream of Glenburnie Road)

Canopy: Swamp Gum; with Black Wattle, Blackwood and Woolly Tea-tree (formerly Yarra Gum and possibly Swamp Paperbark); 12–15 m tall and 10–20% cover.

29.1. Granite Hills Woodland

Conservation status: regionally threatened/disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 20^b

Distribution: disjunct in PLVP B (Quarry Hill)

Landforms: Devonian granodiorite tors (Quarry Hill)

Canopy: Drooping Sheoke–Black Wattle; with Black Sheoke, Tree Violet, Gold-dust Wattle, Lightwood, Blackwood, Hedge Wattle, Golden Wattle, Tree Bursaria, Small-leaf Clematis, Small-leaf Bramble and Cherry Ballart (formerly Tree Banksia) and emergent Long-leaf Box, Yellow Box and Hill Manna Gum; 8–15 m tall and 10–30% cover; remnants are heavily weed invaded (e.g. Hawthorn, Gorse and Montpellier Broom)

Herbs at Quarry Hill: Common Tussock-grass, Weeping Grass and Wattle Mat-rush on sheltered slopes and Kangaroo Grass, Grey Tussock-grass, wallaby-grasses and Common Love-grass on exposed slopes; dominated by alien weeds and grasses

Comments: granite hills woodland is restricted to Devonian granodiorite outcrops of the volcanic plains. It is naturally disjunct and has been eliminated by clearing and grazing in NEM apart from small stands at Quarry Hill.

30.1. Drainage Line Woodland—plains

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 4^a, 5^{bd}, 11^b, 13^b, 15^{be}, 18^c, 21^a

Remnant, degraded or establishing stands: 7^{bc}, 16^a, 18^{bd}, 19^a, 20^b, 22^a, 23^a, 24^a

Distribution: restricted in MUVP, MLVP and PLVP

Landforms: creeks and drainage lines of 6–9 months flow; degraded and fragmented

Canopy: River Red Gum; with Yellow Box and Swamp Gum; 12–15 m tall and 10–20% cover

GEOLOGICAL and LANDFORM/SOIL TYPES of the Volcanic Plains

Silurian Sandstone/Shale

Distribution: MUVB (Epping Road); MLVA (Merri Creek and east of Edwardes Lake Park); MLVB (Merri Creek/Barry Road Gorge); MLVC (Summer Hill); MLVD (Woody Hill); PLVA (Quarry Hill, She Oak Hill and outcrops east of the Plenty River near Bridge Inn Road); PLVB (Quarry Hill); PLVC (east side of the Darebin Creek downstream of Donaldsons Creek at Darebin Parklands and localised occurrences at Howy's and RMIT at Bundoora and the south-east section of Bundoora Park)

Landform/Soil Types: hill-crests and exposed hill-slopes and stream cliffs (Merri Creek)/shallow stony, brown gradational; sheltered hill-slopes and plain-slopes/yellow duplex with shallow sandy loam topsoil; the ironstone red shales of Summer Hill (Craigieburn Road East) are quarried by Craigieburn Clay for the manufacture of terracotta tiles and pipes; close to the granitic intrusions of Quarry Hill the shale beds have been metamorphosed (e.g. cutting along Bridge Inn Road); this was quarried for the manufacture of bricks

Devonian Siltstone

Distribution: MUVB (Epping Road)

Landform/Soil Types: plain-slopes/yellow duplex

Devonian Granodiorite

Distribution: PLVB (Quarry Hill)

Landform/Soil Types: tors and hill-crests/brown duplex granitic sands; hill-slopes/yellow duplex granitic sands; there are several old granitic sand quarries and refractory clay quarries for the manufacture of fire bricks and gravel pits. Granodiorite and granitic sands were extracted from the north end of Gordons Road.

Tertiary Marine Alluvium

Distribution: MLVA (running along the eastern side of Merri Creek between Miller Street and Murray Road at Preston and Sydney Road at Fawkner)

Landform/Soil Types: sand-crests/yellow-red uniform sand; this is part of a stranded coastal dune system (referred to as the Red Bluff Sands of the Brighton Group); the formation is the chief source of moulding sand in the building industry

Tertiary River Alluvium

Distribution: MUVB (west of the Merri Creek from Fawkner to Campbellfield); PLVB (Plenty Road at Blossom Park); PLVC (behind RMIT Bundoora and south-east slopes of Mt Cooper north of Bundoora Park)

Landform/Soil Types: sand-plain/yellow duplex (Tertiary watercourse); the Campbellfield formation contains bands of quartzite, gravel and coarse sands overlying fine-grained plastic clays; the white Campbellfield clays were quarried for the post World War II cream and pink brick and tile industry and for pottery, particularly ceramic whiteware; the clay is high in organic content and is now seldom used in preference to the low organic, kaolinitic Axedale clays

Tertiary Volcanics

Distribution: localised occurrences in MLVB (north of Mahoneys Road at Campbellfield) and PLVC (Plenty Road Bundoora, Parade College to RMIT)

Landform/Soil Types: hill-crest cappings/black cracking uniform clay

Quaternary Volcanics

Distribution: MUVP, MLVP, PLVP

Landform/Soil Types: stony rises, stream cliffs and escarpments and scoria cones/shallow red gradational; stony crests/friable brown uniform clay loams; stony plains/brown duplex; volcanic cones/cone-slopes, gilgai plains and silt plains/grey-black duplex; buckshot crests/yellow duplex (e.g. Scots Church Campbellfield); Mt Fraser is mined for scoria, used as aggregate for lightweight concrete and for gravel road and path surfacing; silt plains are low-lying areas containing surface loams derived from nearby sedimentary outcrops (e.g. northern Craigieburn Grassland and eastern section of the Bald Hill site)

Quaternary Colluvium

Distribution: MUVP A/B (Epping Road); MLVP C (south from Summer Hill to the northern section of Craigieburn Grassland); PLVP A (e.g. small occurrences at the base of She Oak Hill); PLVP B (Quarry Hill); PLVP C (Bundoora Park and the lower reaches of Donaldsons Creek Ivanhoe)

Landform/Soil Types: Silurian/Devonian formation outwash valleys and plain-slopes/yellow duplex with shallow grey loam topsoil; Silurian/Devonian formation gullies and drainage lines/yellow gradational

Quaternary Alluvium

Distribution: MUVP A (Merri Creek floodplain, Hernes Swamp and Spring Creek and gilgais); MUVP B (Merri Creek floodplain); MLVP A (Merri Creek, Edgars Creek and Edwardes Lake floodplains); MLVP B (Merri Creek floodplain); MLVP C (Merri Creek/Summer Hill Drainage Line floodplains); PLVP A (Plenty River, Darebin Creek and Barber Creek); PLVP C (Darebin Creek); widespread small occurrences at volcanic gilgais, stony knoll apron swales, silt plains and other areas with a high water-table and impeded drainage in MUVP, MLVP and PLVP

Landform/Soil Types: stream banks, floodplains and terraces and creeks on Quaternary volcanic formations/grey cracking uniform clay; swamps, gilgais, stony knoll apron swales and silt plain flats/black cracking uniform clay containing high levels of organic peat and silts; alluvial terraces (overlying Quaternary basalt) along the Merri Creek at Coburg contain important marsupial fossil beds (e.g. *Diprotodon optatum*)

MERRI UPLAND VOLCANIC PLAINS (MUVF)

Farmland catchments of the upper Merri Creek from Donnybrook to Wallan East.

Land use

Past land-use: pastoral and townships. Present land-use: pastoral, farmlets, townships and rock extraction.

Native vegetation cover

Fragmented.

Key Biological features

The most significant species are the Red-chested Button-quail, Little Button-quail, Plains-wanderer, Latham's Snipe, Spotted Harrier, Swamp Harrier, Inland Broad-nosed Bat, Southern Lined Earless Dragon, Striped Legless Lizard, Plains Froglet, Common Spadefoot Toad and Small Pepper-cress, Curly Sedge, Tough Scurf-pea and Small Golden Moths.

The most significant habitats are riparian scrub, cliff/escarpment shrubland, stony knoll grassland, plains grasslands and seasonal wetlands (particularly Hernes Swamp and Kalkallo Common).

Of particular note are the faunal rarity, abundance and diversity (particularly quail, birds of prey, lizards and waterbirds) and habitat rarity, abundance and diversity.

Key areas and physical features for biota

The Merri Creek and surrounds at Bald Hill, North Eastern Railway Reserve, Hernes Swamp and Kalkallo Common/Cemetery.

There are five sites of significance: 1 national, 1 state and 3 regional for fauna and 2 very high, 2 high and 1 medium for habitat.

MUVP A MERRI CREEK BEVERIDGE TO WALLAN

This management unit consists of one site of state faunal significance (site 2) and two of regional faunal significance (sites 1 and 3) and surrounding land that forms habitat links.

Map Reference: 7923 252505 to 7923 235547 (Merri Creek); 7823 227513 to 7823 229533 (North Eastern Railway reserve).

Location/Size: East of Mt Fraser between Beveridge and Wallan. Approximately 1200 ha.

Municipality: City of Whittlesea and Shire of Mitchell.

Description: The unit forms the northern section of the Merri Plains grasslands where it comes into contact with the foothills of the Great Divide. Extensive alluvial floodplains have developed in association with the Merri Creek.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands south of the Kilmore Gap, which separates the Eastern and Western Uplands of the Great Dividing Range. It contains the mid-upper reaches of the Merri Creek. Sedimentary foothills of the Kilmore Gap lie to the north.

Landforms

Volcanic plain: cone/cone-slopes (Mt Fraser), stony crests, stony rises, buckshot crests, stony plains, gilgai plains, swamps (Hernes Swamp), swales/stony knoll aprons, creek/escarpments (Merri Creek) and ephemeral drainage lines. Alluvial plain: sedimentary plain-slopes (Merriang Road area) and stream floodplain (Merri Creek). Elevation is 270–424 m (Mt Fraser).

Hydrology

The management unit contains the confluence of two major headwater tributaries of the Merri Creek and is partially landlocked by sedimentary hills, volcanic cones and lava flows, forming an extensive floodplain and swamp system. This is now fully drained. The Merri Creek flows during winter–spring and after rains at other times of the year. The channel of the creek is heavily scoured and contains reedy pools and silt and basalt cobble sections.

Hernes Swamp is about 100 ha and is fed from an intermittent drainage line (now channelled) which rises in the Old Sydney Road hills to the west of Wallan. The swamp is also fed by runoff from the northern slopes of Mt Fraser and hills to the south of Wallan. Inundations are restricted to brief periods during wet winters and springs and following heavy summer rains. It supports grassy wetland along the rail reserve, Cumbungi beds along channels and railway culverts and gilgai plains with small shallow pools of open water when inundated. Adjacent paddocks are grazed.

Before draining, Hernes Swamp was a shallow freshwater marsh covering about 300 ha when full (backing up to the Hume Freeway) and holding water for up to six months. To the west of the Hume Freeway lies 'Inverlochy Swamp' which before draining covered over 600 ha. 'Camoola Swamp,' which covered about 100 ha, lies to the south-east. Together these swamps formed a shallow freshwater marsh system of over 1000 ha. They would have contained stands of swampy woodland near permanent water and extensive freshwater meadows.

Spring Creek is fed from a permanent spring which rises at the south-western foot of Mt Fraser. It contains reed-beds and is surrounded by seasonal wetland. This drains to the west under the Hume Freeway into the Inverlochy Swamp. Stands of Drooping Sheoke probably rimmed the swamp on stony knolls and craters. The spring provides the only permanently flowing watercourse on the Merri Upland Volcanic Plains.

Rainfall: 640–680 mm.

Site 1 Beveridge Rail Reserve

- Map Reference:** 7823 227513 to 7823 229533 (railway); 7923 233517 ('Camoola Swamp'). One minute lat/long grids include 37° 27' x 144° 59' to 145° 00' and 37° 28' x 144° 59' to 145° 00'.
- Location/Size:** Beveridge railway station to Hernes Swamp and areas of stony rises and swampland to the east on 'Camoola'. Approximately 200 ha.
- Municipality:** City of Whittlesea and Shire of Mitchell.
- Land Tenure/Use:** Public: V Line reserve (North Eastern Railway). Private: broad-acre farm settlement with sheep and cattle grazing.
- Landforms:** Volcanic plain (see MUVP A). Elevation is 290–310 m.

Natural Heritage Values

Landscape. Formerly the most extensive shallow freshwater marsh system on the volcanic plains of NEM. The site contains the last relatively extensive and intact area of native grassland remaining along the North Eastern Railway in NEM.

HABITAT SIGNIFICANCE

Assessment: High—Category 2 (assuming Vulnerable/Rare species are extinct)

Partially intact or small stands: Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Kangaroo Grass plains grassland (23.2; when first surveyed in November 1986 the railway reserve contained the most intact stand of Kangaroo Grass plains grassland in NEM and one of the most intact in GM); Brown-back Wallaby-grass seasonal wetland (25.3)

Remnant, degraded or establishing stands: Yellow Box–Hill Manna Gum grassy woodland (14.2; eliminated from the eastern foot-slopes of Mt Fraser); River Red Gum (creek) floodplain riparian woodland (16.6); Common Tussock-grass–Tall Sedge (floodplain herbfield) seasonal wetland (25.5); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Swamp Gum swampy woodland (27.1); Swamp Gum (creek) swampy riparian woodland (28.1; Merri Creek)

Endangered species: Small Golden Moths (reduced to few plants by bulldozing, close to extinction)

Vulnerable species: Swamp Diuris (not located since 1987 as apparently eliminated when plains grassland was bulldozed for fire protection purposes by V Line; last remaining occurrence known in GM)

Rare species: Black-tip Greenhood (as preceding)

Critical assemblages or populations: The Beveridge railway reserve between Beveridge railway station and Hernes Swamp was surveyed in November 1986 and May, August and November 1987. The grassland contained 14 orchid species including three threatened species. This was the most diverse orchid assemblage known to remain on the volcanic plains of GM.

FAUNAL SIGNIFICANCE: Site 1 Beveridge Rail Reserve

Assessment: Regional—Category 2 (C, D, E, F)

Reference grids for the significance keys include:

1^a: 37° 27' x 144° 59'; North East Railway north of Beveridge RS/Camoola Swamp

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Regional. 1^a: 6 species including the Plains Froglet and Bibron's Toadlet at Camoola Swamp on 24 November 1991

l. Reptiles

Regional. 1^a: 8 species including the Cunningham's Skink, Bougainville's Skink and Little Whip Snake in the stony rises fringing Camoola Swamp on 24 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Local. 1^a: 19 species

c. Native mammals

Local. 1^a: 2 species: Echidna and Fat-tailed Dunnart

d. Herpetofauna

Regional. 1^a: 14 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 1^a: 5 species

c. Regionally vulnerable fauna (R2 species)

Regional. 1^a: 1 species. **Mammals:** Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 1^a: 1 species. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 1^a: 3 species. **Birds:** Latham's Snipe, Swamp Harrier. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 1^a: 9 species. **Birds:** Australian Shelduck, Banded Lapwing, Brown Songlark, Singing Bushlark.
Reptiles: Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 1^a: 5 Latham's Snipe (probably several more present) flushed from Camoola Swamp on 24 November 1991

f. Frogs

Regional. 1^a: Over 30 Plains Froglets and Southern Brown Tree Frogs at Camoola Swamp on 24 November 1991

m. Regionally rare fauna (R3 species)

Regional. 1^a: Between 50 and 100 Plains Froglets at Camoola Swamp on 24 November 1991

o. Regionally restricted fauna (R5 species)

Regional. 1^a: 50 Australian Shelducks at Camoola Swamp on 24 November 1991

Outlook

Survey and finding of the Striped Legless Lizard would raise the faunal significance to State. The site is presently Regional Category 2. Diminishing faunal values and poor conservation management will likely see this decline to Category 3. The fauna of the rail reserve was not surveyed until several years after the V Line management works of 1986/87. The removal of rocks eliminated many of the herpetofauna species. The faunal values of the site now pertain to the Camoola Swamp area. Without adequate protection, the values of this area will also decline and the site could become locally significant.

FAUNA

Other Significant Fauna

Birds

Ee/Fa **1^a: Latham's Snipe and Swamp Harrier at Camoola Swamp.** Five snipe were recorded in Common Tussock-grass plains grassland (23.1) at the swamp on 24 November 1991. The swamp has been drained and would have formerly supported Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2; like at Hernes Swamp in site 2). It is heavily grazed and lacks cover. Under conservation management it could become more important for snipe. A Swamp Harrier was seen over the swamp on 24 November 1991.

Ef/Fo **1^a: Australian Shelduck and Banded Lapwing at Camoola Swamp.** Fifty shelduck were recorded in Common Tussock-grass plains grassland (23.1) at the swamp on 24 November 1991. Thirty White and Straw-necked Ibis were also present in the grassland. The swamp meadows were still damp from winter inundation. Six Banded Lapwings were present on Camoola Swamp on 2 June 1994.

Ef **1^a: Breeding Brown Songlark, Singing Bushlark and wintering grassland birds on the North Eastern Railway reserve.** The ungrazed Kangaroo Grass plains grassland (23.2) north of Beveridge railway station forms a breeding area for the Stubble Quail, Brown Songlark and Singing Bushlark. Each was recorded on 24 November 1991. It also forms an important wintering area for Flame Robins. Thirty-two birds were observed perched on a 400 m section of boundary fence in May 1991 (Martin Schulz pers. comm.).

Mammals

Ec **1^a: Fat-tailed Dunnart at Camoola Swamp.** A nest was recorded under a rock in Kangaroo Grass stony knoll grassland (22.1) south-west of the swamp on 24 November 1991.

Reptiles

Ef **1^a: Reptiles of the stony rises fringing Camoola Swamp.** The swamp lies about 1 km north-east of Beveridge railway station. Eight species including the Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink and Little Whip Snake were recorded on 24 November 1991 in Kangaroo Grass stony knoll grassland (22.1), which fringes the south-west side of the swamp. These are cohort species of the Striped Legless Lizard, which was recorded just to the north at Hernes Swamp. Pitfall survey may yield the legless lizard on Camoola.

Frogs

Ed/Fm **1^a: Plains Froglet at Camoola Swamp.** Between 50 and 100 were calling in Common Tussock-grass plains grassland (23.1) at the swamp on the evening of 24 November 1991.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy Habitat connectivity. Intact habitat links to the Hernes Swamp site and the Kalkallo–Donnybrook North Rail Reserve site.	

Farm intensification, rock clearing and grassland cultivation. Further subdivision will intensify the nature of the land-use and alter the broad-acre farmland character of the general area and consequently lower the site's faunal values. Pasture improvements of the surrounding broad-acre paddocks have included rock clearing, top-dressing and sowing of pasture species to increase stock carrying capacity. These processes have converted the sparse native tussock grassland into a pastureland sward. As a result, bird species adapted to tussock grassland (e.g. Plains-wanderer, Red-chested Button-quail and Little Button-quail) which do not inhabit closely grazed swards, may no longer visit the site. These species were recorded to the south in the adjoining Bald Hill site.

Impact of livestock grazing on wetlands and stony knoll grasslands. Heavy grazing at 'Camoola Swamp' and on the adjacent stony rises is limiting their value as waterbird and grassland fauna habitats.

Strengthen habitat links. The site forms an important habitat link to the Merri Creek Donnybrook to Beveridge management unit lying to the immediate south. This needs to be protected in accordance with the Regional Habitat Link Strategy.

Retention of habitat links along the North Eastern Railway will enhance the population viability of native grassland flora and fauna species in the Merri Creek valley.

Native vegetation/rock clearance controls of private land.

Grazing protection and revegetation works.

The riparian link along Merri Creek and sections of Camoola Swamp should be protected and enhanced. The streamway needs to be fenced to enable regeneration and replanting of woodland and shrubland species. This would also stabilise bank erosion caused by livestock. Areas of stony rises south-west of the Camoola Swamp require protection from rock removal and grassland degradation. The stony rises should be fenced to enable native grassland and shrubland regeneration and planting. Sections of grassy wetland at the foot of the stony rises should be included in the grazing enclosure.

Other Issues—North Eastern Railway reserve

Ongoing destruction of rail reserve grasslands. About 75% of the grassland on the Beveridge rail reserve was bulldozed during V Line fire protection works in 1986/87. Much of the remainder is becoming weed invaded. An access track was graded along the western perimeter of the grassland. The grassland now contains only five orchid species. It supported 14 species when surveyed in 1986/87. The threatened Swamp Diuris and Black-tip Greenhood appear to have been eliminated while the endangered Small Golden Moths has been reduced to a few plants. Rail management activities have caused widespread elimination, fragmentation and degradation of grassland and grassy wetland remnants along the rail reserve. Fuel reduction management of rail reserve grasslands since the late 1970s has involved regular grading/bulldozing and application of weedicides. Until this time many railway reserves were burnt annually and contained species-rich native grassland.

Require native grassland and threatened plant protection and weed control. V Line own and manage the railway reserve. Their role is to administer a safe and effective rail system. NRE has an advisory role on issues of conservation. They have the charter to impose conservation measures for threatened species. Endangered species such as the Small Golden Moths at Beveridge need to be protected under the FFG Act. It is recommended that NRE take on a similar charter to protect all identified Very High/National sites of biological significance in this study (see Volume 1).[j1]

A survey for the threatened Swamp Diuris and Black-tip Greenhood should be conducted. A rare or threatened plant agreement needs to be negotiated if either are found to remain. Other rare species are potentially present.

Railway management—weed invasion/fire protection. The associated earthworks have eliminated significant grassland habitat and threatened plant species and have led to weed invasion. A dense introduced grassland sward has developed along the disturbed sections which necessitates ongoing annual fire prevention works such as grading or slashing (see the Bald Hill site).[j2] These swards contain predominantly spring-growing species which die off over summer, presenting a far greater fire hazard than the more open growing Kangaroo Grass, inter-tussock herbs and embedded rocks that were removed. The native grasses were discreet tussock-forming, summer-growing species which contained a high proportion of green, less flammable growth at the time of the fire season. The inter-tussock spaces contained low-growing, mainly non-flammable herb species. These V Line activities would appear to be a cost and works-intensive method of fire protection (see Volume 1).[j3]

Late spring ecological/fuel reduction burns in rail reserve. This should be conducted in the grassland remnants for orchid management (e.g. Blue Fairies which was recorded in 1987) and potential restoration.

No earthworks and broad-scale herbicide spraying beyond 5 m of line. Much of the grassland in the section of the line to the south (see Merri Creek Donnybrook to Beveridge management unit) has been eliminated by V Line activities. This is occurring in the broader rail reserve in this site. Future earthworks beyond the railway radius should be discontinued.

Botanical survey required. The flora of the rail reserve is poorly documented. Botanical survey should be undertaken.

Site 2 Hernes Swamp

- Map Reference:** 7823 230540. One minute lat/long grids include 37° 26' x 144° 59' to 145° 00'.
- Location/Size:** 3 km south-east of Wallan. Approximately 200 ha.
- Municipality:** City of Whittlesea and Shire of Mitchell.
- Land Tenure/Use:** Public: V Line reserve of the North Eastern Railway. Private: adjacent broad-acre farm settlement with sheep and cattle grazing.
- Landforms:** Volcanic and alluvial plains (see MUVP A). Elevation is 280–300 m.

Natural Heritage Values

Landscape. The natural condition, floristic diversity, frequency of rare or threatened swamp plants and relatively low abundance of alien plants in the railway section of Hernes Swamp is highly significant. It contains the most diverse and intact grassy wetland vegetation in NEM and is the only intact wetland of its type remaining north of Melbourne. It is the most significant wetland under the control of V Line in NEM and possibly GM. Hernes Swamp is the designated Critical Conservation Area for grassy wetland habitat in NEM.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point on the Merri Creek at North Station Road Wallan East.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2; Hernes Swamp)

Relatively intact and extensive stands: nil

Partially intact or small stands: Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Kangaroo Grass plains grassland (23.2); Brown-back Wallaby-grass seasonal wetland (25.3)

Remnant, degraded or establishing stands: Common Tussock-grass–Tall Sedge (floodplain herbfield) seasonal wetland (25.5); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Swamp Gum swampy woodland (27.1); Swamp Gum (creek) swampy riparian woodland (28.1; Merri Creek)

Vulnerable species: Barren Cane Grass, Swamp Everlasting, Swamp Groundsel (large population), Swamp Plantain (see site 10; large population)

Rare species: *Agrostis aemula* var. *setifolia*, Swamp Billy-buttons (large population), Pale Swamp Everlasting

Critical assemblages or populations: Grassy Wetland Critical Conservation Area (Hernes Swamp). The most intact stand of Common Tussock-grass–Rush Sedge seasonal wetland in NEM. It supports seven VROT plant species and numerous regionally threatened marshland species. These include the Star-fruit, Rush (*Juncus semisolidus*), Pointed Swamp Wallaby-grass, Dark Swamp Wallaby-grass, Plains Yam-daisy, Hinge-fruit Daisy, Pale Swamp Everlasting and Swamp Starwort.

FAUNAL SIGNIFICANCE: Site 2 Hernes Swamp

Assessment: State—Category 3 (B); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

2^a: 37° 24' x 145° 00'; Merri Creek at North Station Road Wallan East

2^b: 37° 26' x 144° 59'; North East Railway/Hernes Swamp

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 2^b: Striped Legless Lizard (1 on 28 May 1991)

c. Rare fauna

Regional. 2^b: Australasian Bittern, Black Falcon

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 2^b: 11 species at Hernes Swamp on 14 November 1989 and 10 species at the Wallan sewage treatment plant pondages on 28 May 1991

k. Frogs

Regional. 2^b: 7 species including the Plains Froglet and Bibron's Toadlet on 22 February 1990 and 6 species including the Common Spadefoot Toad and Growling Grass Frog on 14 November 1989 at Hernes Swamp

l. Reptiles

Regional. 2^b: 7 species including the Large Striped Skink, Eastern Three-lined Skink and Bougainville's Skink at Hernes Swamp on 14 November 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 2^b: 50 species

c. Native mammals

Local. 2^b: 1 species (Swamp Rat)

d. Herpetofauna

Regional. 2^b: 20 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 2^b: 15 species

b. Regionally endangered fauna (R1 species)

Regional. 2^b: 1 species. **Reptiles:** Striped Legless Lizard

c. Regionally vulnerable fauna (R2 species)

Regional. 2^b: 5 species. **Birds:** Australasian Bittern, Black Falcon, Spotless Crake, Spotted Harrier, Blue-winged Parrot

d. Regionally rare fauna (R3 species)

Regional. 2^b: 1 species. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 2^b: 8 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Swamp Harrier, Peregrine Falcon, White-winged Triller. **Mammals:** Swamp Rat. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 2^b: 10 species. **Birds:** Royal Spoonbill, Great Egret, Australian Shelduck, Brown Songlark, Singing Bushlark. **Reptiles:** Large Striped Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

g. Nesting birds of prey/parrots

Regional. 2^b: Swamp Harrier at Hernes Swamp on 14 November 1989

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 2^b: 12 Latham's Snipe at Hernes Swamp on 14 November 1989

c. Waterfowl

Local. 2^b: 119 individuals of 6 species at Wallan sewage treatment plant pondages on 28 May 1991

o. Regionally restricted fauna (R5 species)

Regional. 2^b: 94 Australian Shelduck at Hernes Swamp and 74 at the Wallan sewage treatment plant pondages on 28 May 1991; over 20 Brown Songlark at Hernes Swamp and the adjoining section of the North Eastern Railway reserve on 24 November 1991

Outlook

Hernes Swamp is drained and carries little water and few waterbirds most years. Conservation management including fencing off the paddocks adjoining the railway reserve and restoring a more permanent flooding regime would increase the wetland values of the swamp and maintain resident populations of waterbirds.

FAUNA

Rare or Threatened Fauna

Bb 2^b: Striped Legless Lizard. One amongst Kangaroo Grass stony knoll grassland (22.1) along a fenceline in a post hole adjacent to a stony rise at Hernes Swamp on 28 May 1991 (Martin Schulz pers. comm.). This population likely extended across the Kilmore Gap to link northern Victorian populations of the species known (formerly) from the Goulburn Valley.

Bc 2^b: Australasian Bittern at Hernes Swamp. One amongst Common Tussock-grass–Rush Sedge seasonal wetland (25.2) in the centre of the swamp on 22 February 1990. This species is the most rarely recorded of the crakes, rails and bitterns in NEM (only five other dispersed locations in NEM during the 1986–1996 survey period). These include Banyule Swamp (site 33), Birrarung Park (site 34), Towts Swamp Glenvale (site 37), Dunnetts Road Swamp Yan Yean (site 38) and in the foothills of the Hume Ranges at Toorourrong Reservoir (site 99). There are historical records from the Lower Yarra. Distribution and movements of the bittern are not well known in Australia.

A larger area surrounding the protected section of Hernes Swamp along the North Eastern Railway should be fenced from stock grazing. Some of the drains need to be filled-in to extend the inundation period and fox control is required. This would enable the Australasian Bittern to increase in numbers. Other waterbird species would likely return and commence breeding and the Swamp Harrier would become resident.[j4]

Australasian Bitterns inhabit dense seasonal wetland at freshwater marshes (25.1/2) on the Plenty and Merri Plains. At billabongs and wetlands near streams (e.g. Toorourrong Reservoir and Banyule Swamp) they inhabit swamp scrub (17.1) and emergent herbfields (27.7) and mudflats in standing water. It is thought that the bittern is a nomadic non-breeding visitor to GM. They appear at wetlands on the plains as they dry out over summer and autumn. In other parts of Australia, a platform-nest is placed amongst grass and sedge tussocks in spring. They are solitary, secretive, nocturnal predators of frogs, fish, crustaceans, snails and insects (Readers Digest 1986). These are taken from jabs into soft mud, vegetation or water while stalking in the shallows.

Fertile alluvial marshlands throughout the plains have been drained and developed for farmland. Few of these containing Australasian Bitterns remain and even fewer occur in areas under conservation management. It is estimated that over 90% of the freshwater marshland habitat of the Australasian Bittern (and the Latham's Snipe, Brown Quail and Buff-banded Rail) on the Plenty and Merri Plains has been lost or rendered substantially unsuitable. Most of the large swamps have been eliminated or degraded. Draining, damming, intense livestock grazing/trampling, cultivation, pollution and the encroachment of settlement have either depleted the vegetation cover and food supply of the wetlands or altered the inundation frequencies. Suitable cover is eliminated by livestock at two of the other freshwater marshes in NEM where Australasian Bitterns have been recorded (Towts Swamp Glenvale and Dunnetts Road Swamp Yan Yean).

Bc 2^b: Black Falcon. One was hunting low over the swamp for quail on 22 February 1990.

Other Significant Fauna

Birds

Ec **2^b: Spotless Crake, Spotted Harrier and Blue-winged Parrot at Hernes Swamp.** Each species was observed on 22 February 1990. A Spotless Crake was flushed from the Cumbungi channel (25.7) at the north end of the swamp. A pair of Blue-winged Parrots was observed taking seed from daisy heads amongst grassy wetland (25.2). Two Spotted Harriers.

Ee **2^b: Brown Quail, Buff-banded Rail and Latham's Snipe at Hernes Swamp.** These cover-dependent waterbirds were recorded on 14 November 1989. The preceding week had received heavy rain. During such periods about 20 cm of surface water covers much of the adjacent low-lying farmland. About 10 Latham's Snipe were observed amongst Common Tussock-grass–Rush Sedge seasonal wetland (25.2) in the railway section of the swamp and Common Tussock-grass plains grassland (23.1) on private land to the east of the rail reserve. The Brown Quail and Buff-banded Rail and another two snipe were observed on mudflats along a Cumbungi-lined drainage channel (25.7) to the west of the railway at the north end of the swamp.

In the dense cover of wet years the swamp and surrounding grassland support Stubble Quail, birds of prey and grassland passerines including the Brown Songlark. On 22 February 1990 pools of water still lay in the gilgais of the swamp from the early November rains. About 10 Stubble Quail were calling from the tussock-grass. Later in the autumn of these years Little Button-quail probably enter the area.

Ee/Eg **2^b: Breeding Swamp Harrier at Hernes Swamp.** A pair nested amongst Common Tussock-grass–Rush Sedge seasonal wetland (25.2) in November 1989. The nesting range of the species has declined greatly in GM due to human disturbance and marshland reclamation. This is the only recent nesting observation in NEM. Increased disturbance during the breeding season may cause the harriers to abandon nesting at the swamp. They nest in wet years when ample cover, water and prey are available (see conservation measures).

Fo **2^b: Substantial population of Australian Shelducks.** Ninety-four were observed in grazing land/Common Tussock-grass plains grassland (23.1) west of the railway reserve at Hernes Swamp on 28 May 1991 (Martin Schulz pers. comm.). This was one of the largest flocks seen during the GM survey. The pondages at Wallan sewage treatment plant lie to the north of Hernes Swamp. These support resident populations of waterbirds, particularly waterfowl (119 individuals of 6 species including 74 Australian Shelduck and 18 Eurasian Coot on 28 May 1991 (Martin Schulz pers. comm.).

2^b: Hernes Swamp—formerly a large and important wetland for waterbirds. Before draining in the 1940s, Hernes Swamp carried a large body of water, which supported thousands of waterfowl and ibis, for extended periods during winter–spring (Tassie McDonald pers. comm.; Bill Payne pers. comm.). At the time of settlement the swamp would have likely supported the Magpie Goose, Australian Bustard and Brolga.

Mammals

Ee **2^b: Swamp Rat at Hernes Swamp.** Found amongst Common Tussock-grass–Rush Sedge seasonal wetland (25.2) in the protected section of the swamp on the railway reserve (about 3 ha). This is the only population known to persist on the volcanic plains in GM. The species is rare in Greater Melbourne except for the southern Mornington Peninsula. The introduced Black Rat is also present.

2^b: Hernes Swamp—former habitat for quolls and the Eastern Barred Bandicoot. Prior to the 1940s, the tussock-grass plains and stony rises surrounding the swamp contained the Eastern Barred Bandicoot, Spot-tailed Quoll and Eastern Quoll (Bill Payne pers. comm.). The stony rises contained stands of Drooping Sheoke and Tree Banksia. Swamp Gum swampy woodland (27.1) and scrub thickets of Woolly Tea-tree occurred in the higher sections of the swamp and along drainage lines. This may have supported the Long-nosed Bandicoot, now also extinct on the volcanic plains of Greater Melbourne.

Reptiles and Frogs

2^b: Hernes Swamp. A diverse assemblage of 20 species was recorded. The regionally rare Plains Froglet is common. The stony rises to the east of the swamp are important for herpetofauna. Little Whip Snakes and Southern Bullfrogs are particularly common.

Freshwater fish

2^a: Electrofishing Survey: Merri Creek–North Station Road Wallan East

Map reference. 7923 240576. **Altitude.** 310 m. **Survey date.** 1 February 1989

Vegetation. Instream: submerged and emergent herbfield (poor condition; 50% cover of algae). Bank: Manna Gum riparian forest (5.3; poor condition; invaded by grassy weeds). Frontage: Swamp Gum swampy woodland (27.1; eliminated)

Physical Features:

Pools

Substrate. Deep silt and logs on sheet sandstone; channel scoured. The creek was composed of a chain of pools with no connecting flow

Maximum size (mid-summer). 3.0 m wide by 1.2 m deep by 30 m long

Riffles

Substrate. Sand and gravel on sheet sandstone

Flow (mid-summer low): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Water quality

Summer: Temperature. 17.0°C. **Conductivity.** 800 ms. **Turbidity.** Cloudy

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (6); migratory sub-adults

Alien species numbers/status. Nil

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. An intact habitat link to the Beveridge Rail Reserve site.

Grassy Wetland Critical Conservation Area. The site is the designated Critical Conservation Area for grassy wetland habitat in NEM. This would require conservation management of the V Line reserve and adjacent private land.

<p>Poor population viability of the Striped Legless Lizard in fragmented habitats. Linear grassland strips along railways and roadsides on the volcanic plains of GM are usually surrounded by alienated pasture. Few of these west of Melbourne, even though they may support native grassland identified as botanically significant (e.g. Stuwe 1986, McDougall 1987), were found to contain the Striped Legless Lizard. In three localities, the lizard only occurred in adjacent paddocks which supported extensive rocky grassland (Beardsell in prep.). Small grassland remnants amongst suburbia, isolated patches in alienated farmland and refugia along linear, disturbed roadside and railway reserves appear to be incapable of supporting viable populations of most ground fauna species.</p>	<p>The long-term viability of populations of many grassland ground fauna species is dependent on the reservation or conservation management of extensive and connecting (ideally intact) habitat patches.</p>
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Regional Hydrological Strategy

Draining/clearing has caused extensive loss of wetland values at Hernes Swamp. Wetland and grassland faunal values of sections of Hernes Swamp on private land outside the railway reserve have been reduced by draining. These grasslands and grassy wetlands have been substantially cleared or modified since European settlement. The drainage pattern of the swamp has been greatly altered. Dams are present in the catchment and a several deep drains run through the swamp. These have reduced the ability of the swamp to fill or retain water. It rarely contains water for extended periods, nor does it support large numbers of waterbirds.

The North Eastern Railway embankment and culverts have fragmented the wetland into two sections; the most significant section of marshland occurs to the west of the line. A V Line access track west of the line bisects the swamp. A number of potentially invasive weeds (e.g. *Lilaea* and Toowoomba Canary-grass) have arisen from the access track. There are table drains with some permanent open water along both sides of the railway near the northern (deeper) end of the swamp. These drains and a channel running through the swamp support Cumbungi beds.

Wallan sewage treatment plant. The water quality of the Merri Creek downstream in the Bald Hill site has noticeably declined (e.g. algae in pools) since the commissioning of the plant. In combination with the summer dewatering of the creek by catchment dams, additional plants in the system may eliminate species such as the Freshwater Blackfish and Platypus from downstream.

Conservation management plan and restoration of flooding regime at Hernes Swamp. Given the biological significance and the potential for further habitat degradation to occur in the swamp, a conservation management plan including the return of a more natural flooding regime should be implemented. Partial blockage with bluestone or the construction of a floodgate in the central drain would greatly increase the water retention capacity of the swamp. This would improve the flooding regime for waterbirds and the breeding habitat of quail and birds of prey. The creation of wetland further away from the disturbance of the railway line would increase the waterbird nesting habitat. The swamp will require ongoing selective weed control.

The likely elevation of wetland fauna values arising from restoration programs should be monitored. The swamp lies within a sparsely settled section of NEM, has no direct or easy access and is seldom disturbed by people, except the rail management. It swamp will need to remain isolated from human disturbance if the Swamp Harrier is to continue breeding.

Sewage treatment plants. Any new sewage treatment plants should require a full environmental impact assessment. The requirements of the EIA should follow those presented in the Summerhill Road site (regarding the Pakenham Blue Metal quarry).[j5] If stream conservation values are to be maintained there must be stricter controls on emissions into the Merri Creek. Additional filtration pondages at the Wallan sewage treatment plant may be necessary. Management of the pondages could be improved for fauna conservation. For example, establishing Common Reed–Cumbungi beds fringing the dirt-lined pondages would attract cover-dependent crakes and rails (particularly the Australian Spotted Crake). Providing nesting platforms may facilitate breeding amongst the shelduck, teal and Pacific Black Duck.

<p>Grazing/trampling and siting of dams in farmland surrounds of Hernes Swamp. The site has undergone recent pastoral land management intensification—for instance a change in grazing regime from broad-acre sheep grazing to higher intensity grazing by cattle on subdivision farms. The siting of dams and watering points in the swamp to provide permanent water has concentrated stock grazing and trampling, resulting in waterbird habitat loss and deterioration.</p>	<p>Stock exclusion from surrounding private land sections of Hernes Swamp. Sections of the swamp on private land on both sides of the railway and the stony rises to the east of the railway should be fenced and excluded from grazing. Exclusion of stock would permit natural regeneration of waterbird habitat and attract greater numbers of waterbirds. The return of permanent water and fencing the paddock areas of the swamp may enable the Swamp Harrier to become resident.</p>
<p>Pasture improvement and rock clearing in farmland surrounds of Hernes Swamp. Farmland is heavily grazed by cattle, horses and sheep; areas of rocks and native grassland have been removed, sown for pasture and heavily supered; some areas have been cultivated.</p>	<p>Implementation of Native Vegetation Clearance Controls on railway land and private land. This should specify controls on removal of native rock or grassland</p>
<p>Declining water quality of Merri Creek—high erosion hazard and degradation of stream banks and vegetation by livestock. Livestock have direct access to the Merri Creek from both sides. The native tree and shrub vegetation is severely depleted and the Swamp Gums are dying from senescence, salinity and grazing related causes. There is lack of summer stream flow due to clearing of forests and damming in the catchment. The water appears polluted. Nitrogen/phosphorous enrichment has resulted from the washing in of stock faeces from paddocks. Algal blooms causing severe oxygen depletion and eutrophication of the water occurs during summer. Severe bank erosion, loss of vegetation and slumping from livestock grazing has occurred.</p>	<p>Restoration of the streamway habitat link.</p> <p>Monitor/improve water quality of the Merri Creek. The poor water condition should be addressed as this feeds more significant sections downstream. Water salinity is a major issue.</p> <p>Streamway livestock exclusion zone. The streamway requires fencing to enable regeneration and replanting. Land protection works such as weed and erosion control are also required.</p>

Conservation Measures for Other Issues

Negotiation and implementation of a V Line/NRE Category 2 threatened plant agreement at Hernes Swamp. The section of Hernes Swamp contained on the railway reserve is identified as a Category 2 threatened plant protection agreement area between V Line and NRE. In the absence of stock grazing the diverse marshland flora along this section has regenerated naturally .

Wetland flora and fauna may require management burning. A control burn was conducted along a strip immediately west of the railway line in early 1987. This strip now contains a large population of the vulnerable Swamp Everlasting and Swamp Groundsel. These species have benefited from the burn. However, the burn has promoted the spread of some alien plants (e.g. Strawberry Clover) and may be implicated in the disappearance of the Plains Yam-daisies. The effect on the Swamp Rats is unknown (the area supporting the majority of the runways was burnt). Further research is required into fire management of the swamp (e.g. effect on the Striped Legless Lizard). The lizard requires dense, unburnt grassland (see Craigieburn Grassland site). Given the dominance of grasses, a mosaic burning regime on a 5–10 year rotation may be beneficial for many of the inter-tussock species of plants present (e.g. composites).

Site 3 Spring Street Swamp Beveridge

Map Reference:	7823 209503. One minute lat/long grids include 37° 28' x 144° 58'.
Location/Size:	Both sides of Spring Street and south of Beveridge Road at the south-western corner of Beveridge township and southern foot of Mt Fraser. Approximately 10 ha.
Municipality:	Shire of Mitchell.
Land Tenure/Use:	Public: east of Spring Street (water reserve). Private: between Spring Street and the Hume Freeway. The reserve is agisted for livestock grazing. The township of Beveridge occurs to the immediate north and east. Broad-acre grazing land occurs to the south.
Landforms:	Volcanic plain (see MUVPA). Elevation is 270 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Common Tussock-grass–Tall Sedge (floodplain herbfield) seasonal wetland (25.5); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7)

Remnant, degraded or establishing stands: Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Swamp Gum swampy woodland (27.1)

Notable features: Permanent spring and stand of about 50 Woolly Tea-trees and regionally threatened marshland species including Tassel Sedge and Victorian Club-sedge. Clearing and draining of the creek and marshland has left the stand of Woolly Tea-tree isolated from the next nearest stands along the Merri Creek. The tea-trees are large and old and occupy peaty, saturated soils. Spring Street Swamp is the last remnant (1–2 ha) of the formerly extensive (perhaps exceeding 500 ha) Inverlochy Swamp to the west.

FAUNAL SIGNIFICANCE : Site 3 Spring Street Swamp Beveridge

Assessment: Regional—Category 3 (C, D, E, F)

Reference grids for the significance keys include:

3^a: 37° 28' x 144° 58'; Spring Street Swamp Beveridge

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 3^a: 10 species including the Brown Quail, Australian Spotted Crake and Latham's Snipe at Spring Street Swamp on 24 November 1991

k. Frogs

Regional. 3^a: 6 species including the Growling Grass Frog and Plains Froglet on 11 November 1991

l. Reptiles

Local. 3^a: 4 species including the Eastern Three-lined Skink and Eastern Brown Snake from stony crests along a fenceline to the south of Spring Creek Swamp on 11 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Local. 3^a: 32 species

d. Herpetofauna

Regional. 3^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 3^a: 6 species

d. Regionally rare fauna (R3 species)

Regional. 3^a: 2 species. **Birds:** Australian Spotted Crake. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 3^a: 4 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Rufous Songlark

f. Regionally restricted fauna (R5 species)

Local. 3^a: 4 species. **Birds:** Brown Songlark. **Reptiles:** Bougainville's Skink, Tussock Skink, Little Whip Snake

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 3^a: 10 Latham's Snipe on 24 November 1991 and 6 on 11 November 1991 at Spring Street Swamp

f. Frogs

Regional. 3^a: A chorus of over 30 Growling Grass Frogs and 30 Common Bullfrogs heard at Spring Street Swamp on 24 November 1991

Outlook

With management that included restriction of livestock grazing to attract additional waterbirds and replanting of Woolly Tea-tree and Swamp Gums to attract additional woodland birds, the faunal significance would increase to Regional Category 2.

FAUNA

Other Significant Fauna

Birds

Ed 3^a: Australian Spotted Crake at Spring Street Swamp. Single bird flushed into the reed-beds (25.7) from the floodplain herbfield (25.5) along the drainage line on 24 November 1991.

Ee 3^a: Brown Quail, Buff-banded Rail and Latham's Snipe at Spring Street Swamp. Only brief visits have been made to the site. Tall Sedge–Common Tussock-grass (floodplain herbfield) seasonal wetland (25.5), Common Reed (emergent herbfield) seasonal wetland (25.7) and mudflats of Spring Creek Swamp provide excellent waterbird habitat. There is an abundance and diversity of food including aquatic plants (Common Duckweed and Pacific Azolla) and mudflat invertebrates (damselflies, worms, shell-shrimps, molluscs and crustacea). A single, dark female Brown Quail flushed into the reed-beds from the floodplain herbfield along the drainage line on 24 November 1991. A Buff-banded Rail was seen in rank grassland along the Spring Street table drain at the crossing of Spring Creek on 5 June 1991 (Martin Schulz pers. comm.).

Ten Latham's Snipe flushed from the eastern section, across Spring Street to the western section of the swamp on 24 November 1991. Six snipe were also present on 11 November 1991. The permanently moist mudflats and herbfields of Spring Creek provide one of the best feeding areas for snipe on the volcanic plains of NEM. This international migratory species is uncommon at ephemeral wetlands on the volcanic plains (compared with the alluvial plains, which remain inundated for longer periods). Ephemeral wetlands are usually dry by the main visiting time of snipe (November to January) and the hard-pan substrates are generally unsuitable for mud-probing species. Areas of regional or higher significance for Latham's Snipe are protected under the JAMBA and CHAMBA treaties.

Large waders such as the White-necked Heron, White-faced Heron and Yellow-billed Spoonbill also visit Spring Street Swamp. The reeds contain the Clamorous Reed Warbler, Little Grassbird and Golden-headed Cisticola. The habitat along Spring Creek has potential to support the rare Australasian Bittern and Lewin's Rail, regionally vulnerable Spotless Crake and possibly some international migratory waders such as the Sharp-tailed Sandpiper (particularly in late February/early March when they stop off at wetlands in NEM before returning home). With more extensive searching these species might be recorded, particularly if the swamp was

under more beneficial management such as grazing exclusion. Protection from disturbance by dogs and humans and predation from cats and foxes would further enhance the waterbird diversity.

Ee **3^a: Rufous Songlark, Brown Songlark and Stubble Quail.** Both songlarks were observed on 24 November 1991. A male Brown Songlark (*Ef*) was performing territorial/courtship songflights amongst the tall grassland fringing Spring Creek Swamp and the Rufous Songlark, which was also performing songflights, was a short distance away in a large Sugar Gum at the rear of an old farmhouse. The behaviour of both species was suggestive of breeding. Several male Stubble Quail were calling from the grassland surrounding the swamp.

Frogs

Ed **3^a: Plains Froglet.** One observed at Spring Street Swamp on 11 November 1991. This is essentially an inland (Eyrean) species in Victoria. Its range extends through the Kilmore Gap of the Great Divide from northern Victoria onto the Merri and Plenty Plains of southern Victoria. A chorus of over 60 Growling Grass Frogs and Common Bullfrogs was heard on the warm, sultry late afternoon of 24 November 1991.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Surrounding habitat links, while degraded and partially severed, still function for birds and probably most ground fauna species. Rock clearing of paddocks has restricted the movement of the stony knoll reptiles.</p>	
	<p>Rezoning of the Crown Land area to a bushland reserve. This is recommended as recognition of its role in providing important habitat for international migratory birds.</p>
Regional Hydrological Strategy	
<p>Poor conservation status of wetlands on the volcanic plains in NEM. Wetlands have been extensively cleared and drained on the Merri Plains. Most of the very few natural areas remaining are subjected to severe degradation and their long-term viability as habitat for wetland flora and fauna is poor. Substrate damage, nutrient enrichment and weed invasion due to livestock at Spring Street Swamp. Livestock have damaged the black soil at the fringe of the drainage line herbfields. Pugging in the damp brown alluvial soil under the tea-tree near the spring has been severe. Nutrient enrichment and ground disturbance from livestock have led to weed invasion, particularly blackberry, Blue Periwinkle, English Ivy, Aster-weed, Jointed Rush, Water Couch, Annual Beard-grass, Two-row Bitter-cress and Spear Thistle.</p> <p>Decline and lack of regeneration of Woolly Tea-tree at Spring Street Swamp. Grazing and trampling has prevented adequate regeneration of the Woolly Tea-tree and the old plants are slowly dying. These are being replaced by grazing tolerant species such as Hawthorn and Blackberry.</p>	<p>Fencing to allow rehabilitation and natural regeneration. If the seasonal wetland and surrounding grassland were protected from livestock, land degradation processes would rehabilitate and natural regeneration would occur and the area would provide improved habitat for fauna. To protect the wetland area of the town common section of the Spring Street Swamp a fence may need to be erected. Preferably the whole Crown land area should be ungrazed. If grazing was considered necessary for fire protection, strip enclosures of mobile electric fence along the edges abutting the township could be grazed in summer.</p>

Salinity indicators at Spring Street Swamp.

The appearance of the invasive weed Sharp Rush and presence of extensive areas of the native Streaked Arrow-grass are indicators of salinity.

Improvement in water quality regarding wastewater/sewage effluent from Beveridge.

Water contamination sources from nearby Beveridge should be reduced.

Other Issues

Weeds. Blackberry and outbreaks of Sharp Rush constitute a threat to the conservation values of the site

Potential for wetland conservation and interpretation. In the context of the Merri Volcanic Plains, Spring Street Swamp is one of the few natural wetlands remaining. The diversity of wetland and grassland habitats present, with assistance through regeneration and species enrichment plantings, provides a high potential for wetland conservation. Given its access, the site would be excellent as a public interpretation area.

Require a community conservation group; liaison with NRE/Shire of Mitchell. The formation of a local community conservation group would greatly assist these works. Input from the Department of Conservation and Natural Resources and the local council (Mitchell) may be required regarding the control of weeds and availability of indigenous plants. Land holders of sections of the site should be approached and informed of its conservation values in an effort to alter land-use so as to improve natural habitat.

MUVP B MERRI CREEK DONNYBROOK TO BEVERIDGE

This management unit consists of one site of national faunal significance (site 4) and one of regional faunal significance (site 5) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7822 196429 to 7923 251505 (Merri Creek).

Location/Size: Merri Creek and surrounding catchment between Donnybrook Road and Beveridge Lane. Approximately 2300 ha.

Municipality: City of Whittlesea and Shire of Mitchell.

Description: The eastern edge of the unit contains a contiguous native vegetation link of broad-acre grassland/grazing land flanking the Merri Creek. The North Eastern Railway traverses the western edge. Blocks within the unit contain a mosaic of rock-cleared or cultivated paddocks and rocky areas.

PHYSICAL FEATURES

The management unit lies on the volcanic plains of the Eastern Uplands and contains the mid-reaches of the Merri Creek.

Landforms

Volcanic plain: cone/cone-slopes (Bald Hill), stony crests, stony rises, stony plains, buckshot crests, gilgai plains, swales/stony knoll aprons, creek/escarpments/cliffs (Merri Creek) and ephemeral drainage lines. Alluvial plain: sedimentary plain-slopes (Merriang Road) and stream floodplain (Merri Creek Glenburnie Road to Merriang Park). At the head of the Merri Creek gorge upstream of Donnybrook, the creek valley has a broader floodplain. The Merri Creek has lower columnar basalt cliffs and less extensive terraces, boulder screes and escarpments than downstream in MLVP C. The creek bed contains rocky riffles, basalt cobbles, tessellated basalt pavement and rock shelves forming small waterfalls below reedy pools. Elevation is 220–357 m (Bald Hill).

Hydrology

The Merri Creek upstream of Donnybrook is ephemeral, running in winter–spring and after summer rains.

Rainfall: 620–640 mm.

Site 4 Bald Hill

- Map Reference:** 7822 214462 to 7823 238477 (Merri Creek); 7822 229466 (trapping site on the Merri Creek at the boundary of 'Hillside', 'Braelands' and 'Merriang Park'); 7822 230428 ('Donnybrook Road Lake'). One minute lat/long grids include 37° 30' x 144° 59' to 145° 00', 37° 31' x 144° 59' to 145° 00' and 37° 32' x 144° 59'.
- Location/Size:** Merri Creek and surrounding catchment east of Bald Hill on 'Braelands', 'Hillside', 'Merriang Park' and adjacent properties. Approximately 1300 ha.
- Municipality:** City of Whittlesea and Shire of Mitchell.
- Land Tenure/Use :** Private: land pending permit for zoning as extractive and owned by Boral Australia (Braelands) or under lease to Boral Australia pending zoning as extractive (Hillside); remainder is rural broad-acre farm settlement with sheep and cattle grazing.
- Landforms:** Volcanic and alluvial plain (see MUVB). Elevation is 240–280 m.

Natural Heritage Values

Landscape. These assessments are based on the condition when surveyed in 1987/88, before recent land management which has contributed to an appreciable (but not irreversible) decline in values. The site contains the most diverse assemblage of volcanic plains landforms in NEM. These support one of the most diverse and representative volcanic plains fauna and faunal habitat assemblages known. The riparian and grassland landscape at the trapping site was after Craigieburn Grassland one of the most intact occurring on the volcanic plains of NEM. These landscapes and their conservation values are poorly represented and maintained elsewhere.

The broad-acre farms are among the most remote and least disturbed by land-use on the volcanic plains of NEM. The site has comparable grassland 'wilderness' landscape values to the Little River Gorge (WM) and is the equal to any on the Western Volcanic Plains. Relatively low density settlement and land-use intensity has protected these values.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point on the Merri Creek above the rail bridge 3 km north-east of Kalkallo.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: nil

Relatively intact and extensive stands: Woolly Tea-tree riparian scrub (18.2); Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Kangaroo Grass plains grassland (23.2); Brown-back Wallaby-grass seasonal wetland (25.3); Blunt Pondweed permanent wetland (26.1; Donnybrook Road Lake)

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1); **River Red Gum (plains) drainage line woodland (30.1; 'Bald Hill Creek');** Lightwood–Tree Violet cliff/escarpment shrubland (20.5)

Remnant, degraded or establishing stands: Yellow Box–Hill Manna Gum grassy woodland (14.2; remnants on the eastern foot-slopes of Bald Hill); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; eliminated from Bald Hill)

Endangered species: Swollen Swamp Wallaby-grass, Tough Scurf-pea

Vulnerable species: Curly Sedge

Rare species: Water Starwort (*Callitriche umbonata*), Slender Tick-trefoil, Dusky Scurf-pea

Critical assemblages or populations: Southern Lined Earless Dragon Critical Conservation Area (Merri Creek east of Bald Hill). One of the most extensive and intact areas of plains grassland and stony knoll grassland in

NEM. The site contains one of the highest representations of plant communities (seven) on the volcanic plains of GM. Most habitats and VROT plant species are threatened by current livestock grazing.

FAUNAL SIGNIFICANCE: Site 4 Bald Hill

Assessment: National—Category 3 (B); State (B, C, D, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

4^a: 37° 30' x 144° 59'; Merri Creek east of Bald Hill

4^b: 37° 32' x 144° 59'; Donnybrook Road Lake

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

National. 4^a: Southern Lined Earless Dragon (one seen on 18 October 1988)

b. Vulnerable fauna

State. 4^a: Plains-wanderer (one seen on Braelands in 1983; included in post-1986 analysis as almost certainly still present; time constraints prevented searching for the Plains-wanderer or Striped Legless Lizard during this study)

c. Rare fauna

Regional. 4^a: Red-chested Button-quail, Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 4^b: 21 (13 waterfowl and 8 wader) species present at Donnybrook Road Lake on 28 May 1991

h. Bats

State. 4^a: 8 species including the White-striped Freetail Bat Southern Forest Bat and Inland Broad-nosed Bat trapped along the Merri Creek near the Gas and Fuel pipeline between 1 and 3 March 1989

k. Frogs

Regional. 4^a: 6 species including the Plains Froglet and Striped Marsh Frog near the bat trapping site between 1 and 3 March 1989

l. Reptiles

Regional. 4^a: 8 species including the Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake and Lowland Copperhead in a 2 hour herpetofauna search of stony rises about 500 m upstream of the North Eastern Railway bridge on 18 October 1988

m. Freshwater fish

Regional. 4^a: 2 species (2 Short-finned Eels and 1 Freshwater Blackfish) at the Merri Creek electrofishing site upstream of the North Eastern Railway bridge on 1 February 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 4^a: over 90 species

b. Native birds

Regional. 4^a: over 50 species

c. Native mammals

Regional. 4^a: 14 species

d. Herpetofauna

State. 4^a: 25 species

e. Freshwater fish

Local. 4^a: 2 species

f. Butterflies

Local. 4^a: 13 species (diverse for the volcanic plains)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 4^a: 19 species

b. Regionally endangered fauna (R1 species)

State. 4^a: 4 species. **Birds:** Red-chested Button-quail, Little Button-quail. **Mammals:** Inland Broad-nosed Bat.
Reptiles: Southern Lined Earless Dragon

c. Regionally vulnerable fauna (R2 species)

Regional. 4^a: 5 species. **Birds:** Spotted Harrier, Black Kite, Black Falcon. **Mammals:** Fat-tailed Dunnart. **Fish:** Freshwater Blackfish

d. Regionally rare fauna (R3 species)

Regional. 4^b: 4 species. **Birds:** Australasian Shoveler, Pink-eared Duck, Hardhead, Musk Duck

Regional. 4^a: 2 species. **Birds:** Black Falcon **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 4^a: 9 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Whistling Kite, Rainbow Bee-eater, White-winged Triller, Striated Fieldwren, Rufous Songlark. **Butterflies:** Small Copper

f. Regionally restricted fauna (R5 species)

Regional. 4^a: 13 species. **Birds:** Banded Lapwing, Cattle Egret, Australian Shelduck, Barn Owl, Long-billed Corella, Singing Bushlark. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

Local. 4^b: 2 species. **Birds:** Great Egret, Australian Shelduck

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 4^a: 5 Latham's Snipe near the junction of Bald Hill Creek and Merri Creek on 18 October 1988

c. Waterfowl

Regional. 4^b: 203 individuals of 13 species on Donnybrook Road Lake on 28 May 1991

m. Regionally rare fauna (R3 species)

Regional. 4^b: 8 Hardhead and 8 Pink-eared Duck at Donnybrook Road Lake on 28 May 1991

n. Regionally depleted fauna (R4 species)

Regional. 4^a: 8 Rainbow Bee-eaters along Bald Hill Creek on 18 October 1988; over 50 Small Copper butterflies above the eastern escarpment of the Merri Creek near the boundary of Braelands and Merriang Park on 18 October 1988

o. Regionally restricted fauna (R5 species)

Regional. 4^a: 46 Australian Shelduck in plains grassland at Braelands on 5 June 1991

Regional. 4^b: 25 Australian Shelduck at Donnybrook Road Lake on 28 May 1991

Outlook

The clearing of surrounding rocky grassland has partially severed habitat links for ground fauna. The impact of increasing land-use intensity (e.g. heavy livestock grazing, removal of rocks from paddocks and weed invasion) over the last 10 years has led to a deterioration in biological values. The substantial population of foxes is threatening the ground fauna.

FAUNA

Rare or Threatened Fauna

Ba **4^a: Southern Lined Earless Dragon.** This species has been recorded in Victoria in the last decade from only four localities (all in GM). These include Bald Hill (this site), Craigieburn Grassland (site 10) and the Little River Gorge upstream of Little River township and Jacksons Creek near Diggers Rest. At Bald Hill, the dragon was located in Kangaroo Grass stony knoll grassland (22.1) on 18 October 1988. The area was near a rock wall where a stony crest extends in a continuous band from boulder scree and cliffs along the Merri Creek onto the stony plains. The rock wall formed a boundary between two properties. North of the wall was heavily grazed by sheep. The south (Hillside) had been subjected only to low intensity cattle grazing over an extended period.

The combination of dry, open ground with sparse tussocks of Short Wallaby-grass and extensive areas of embedded rock abutting dense tussock cover of Kangaroo Grass occurs at each of the four sites where the dragon was recorded in GM. The species was not subsequently recorded at Bald Hill during pitfall trapping studies conducted by NRE officers in 1995 (Peter Robertson pers. comm.). There is concern over whether it survives in the locality (see Threatening Processes).

Extensive areas of grassland and embedded rock habitat flank several sections of the Merri Creek at Bald Hill. The Merri Creek gorge and associated fencelines have partly protected the escarpment, riparian and adjacent stony knoll habitat from excessive stock grazing. The broad-acre farms of the Bald Hill site offer extensive, relatively unmodified and intact habitat. As a result, they support threatened fauna species such as the Earless Dragon that are rare or absent elsewhere in NEM.

Earless Dragons have become very rare and are extremely difficult to locate. They require a 'stealth' approach rather than active searching such as lifting rocks. None have been located in GM under surface rocks using the latter technique. The dragon inhabits underground dens (probably excavated by Wolf Spiders, Fat-tailed Dunnarts or House Mice) at the end of long, narrow tunnels. These often contain an entrance at the base of an embedded basalt rock. The dragon at Bald Hill was observed by binoculars amongst a rock outcrop. For much of the time it lay motionless and alert with head raised, in waiting for passing prey. The animal was small (6–8 cm long) and its mottled, creamy-yellow and light brown markings were camouflaged by dappled background shadows cast by the rocks and grass tussocks. Stone fences surrounded with embedded rock appear critical for the survival of the species (see site 10).

Little is known about the breeding and feeding behaviour of the Earless Dragon. They are presumably egg-laying. Most dragons excavate special incubation burrows for their eggs (Peter Robertson pers. comm.). It is likely that the Earless Dragon uses such burrows during early summer, the heat-conducting rocks providing an incubation chamber. An individual at Little River in January 1990 was observed pouncing on ants, grasshoppers, flies and a tiger moth. It chased prey or escaped from danger with swift bursts of speed. It was also capable of climbing vertical rock faces. The species appears to occupy only a small territory, seldom moving far from its sunning/scanning sites and den. The individual at Little River ranged over a small area of less than 20 m² amongst the grass tussocks and rocks.

Earless Dragons were apparently widespread and moderately common on the volcanic plains near Melbourne at the time of European settlement (e.g. Yarra Bend, 1880s). Many of these localities are now in the urban area and the natural habitat has been destroyed. Remaining areas are becoming intensively farmed. Loss of native grassland and rocks which provide cover/breeding habitat and protection from fox predation is threatening the species (see Management).

Within Australia, the Southern Lined Earless Dragon now only occurs on the western volcanic plains of GM and around Canberra. The former area is the driest part of southern Victoria (annual rainfall 450–620 mm) and connects via the Kilmore Gap in the Great Divide to areas in northern Victoria where the dragon once occurred. The genus to which this dragon belongs is typically inland Australian (Eyrean) in range. Similar to the Striped Legless Lizard, the former range of the Earless Dragon was naturally disjunct in the foothills and plains of the low, uniform seasonal distribution rainfall zone of south-eastern Australia. A number of endangered grassland plants including the Button Wrinkle-wort and Small Scurf-pea share comparable range disjunctions. The uniform rainfall zone only extends into the far western edge of NEM on the Merri Volcanic Plains.

- Bb* **4^a: Plains-wanderer.** One seen in the late summer of 1983 in low, open tussock grazing land (ex-Kangaroo Grass plains grassland; 23.2) dominated by Bristly Wallaby-grass and Velvet Tussock-grass on 'Braelands' (local quail shooter pers. comm.). Searches for the species were not conducted during the survey. Specific survey (e.g. night spotlighting by vehicle or day searches with trained dogs) needs to be conducted to locate the elusive Plains-wanderer. It is likely to still persist.
- Bc* **4^a: Red-chested Button-quail.** Pair observed in a large stand of tall, dense (only lightly grazed) Kangaroo Grass stony knoll grassland (22.1) and Kangaroo Grass plains grassland (23.2) at Hillside to the west of the Merri Creek on 2 March 1989. There were only four other sightings in NEM (site 5 at Kalkallo Common, site 10 at Craigieburn Grassland, site 14 at Woody Hill Swamp and site 15 at Fenwick Stud). The Bald Hill site lies within the Kilmore Gap biogeographic system and contains the strongest assemblage of inland avifauna in NEM. These species include the Little Button-quail, Red-chested Button-quail, Black Kite, Spotted Harrier and Black Falcon. They are considered vagrant or irregular visitors to other parts of NEM.
- Bc* **4^a: Black Falcon.** One was observed perched amongst River Red Gum grassy woodland (14.1) during the bat trapping survey of 1 to 3 March 1989.
- Bc* **4^a: Freshwater Blackfish.** One was taken during the electrofishing survey from the reedy pools upstream of the North Eastern Railway bridge on 1 February 1989. There are only small populations remaining in the Merri Creek. This species has been eliminated in recent decades from the inner sections of streams around Melbourne (e.g. lower Plenty River). Once plentiful, it is now absent from the Merri Creek below the Craigieburn regional sewage treatment plant outlet. The polluted water in the stream below the Cooper Street tips contains predominantly alien species (e.g. Roach, Redfin, Mosquito Fish and Goldfish). The future survival of the Freshwater Blackfish in the Merri Creek is insecure given the commission of a sewage treatment plant at Wallan and the likely commission of additional plants as residential and industrial development proceeds.

Critical Assemblages or Populations

- Ch* **4^a: High diversity of bats on the Merri Creek east of Bald Hill.** Eight species including 1 White-striped Freetail Bat, 2 Inland Broad-nosed Bats and 6 Southern Forest Bats were trapped in Woolly Tea-tree riparian scrub (18.2) along the Merri Creek between 1 and 3 March 1989. The trapping effort involved nine trapnights. Harp traps were placed over pools under overhanging River Red Gum branches.
- Dd* **4^a: High diversity of herpetofauna.** With the exception of Craigieburn Grassland, the site supports the most diverse assemblage of reptiles and frogs on the volcanic plains of GM. Twenty-five species were recorded. They included substantial populations of the Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake and Lowland Copperhead (extension along the creek onto the Merri Plains from nearby upland areas). The site connects significant areas of volcanic plains grassland habitat to the south. Pitfall trapping of rocky grassland areas would likely locate the Striped Legless Lizard. This species occurs in sites to the north and south along the Merri Creek.

Other Significant Fauna

Birds

- Eb* **4^a: Little Button-quail.** Two sightings were made in NEM in June 1991 during a local irruption from the inland. One of these was at O'Herns Road Swamp (site 12). A single bird was seen in the Bald Hill site on 5 June 1991. It flushed from the edge of recently ploughed grassland into Common Tussock-grass plains grassland (23.1) in freshwater meadows above Bald Hill Creek, just upstream of the Merri Creek. Little suitable native seed was present in the locality. The bird had been feeding on the corms of the introduced Common Onion-grass, exposed by the ploughing.
- Ec* **4^a: Spotted Harrier and Black Kite .** Each of these regionally vulnerable birds of prey species is characteristic of the north-western plains of Victoria. They are largely late summer–autumn visitors to NEM, influenced by inland drought and local seasonal conditions causing prey abundance (e.g. House Mice and quail). Each was observed near the corner of Hillside, Braelands and Merriang Park during the bat trapping survey of 1 to

3 March 1989. The Spotted Harrier was hunting over Common Tussock-grass plains grassland (23.1). The Black Kite was coursing along the Merri Creek over Woolly Tea-tree riparian scrub (18.2).

- Ed* **4^a: Australasian Shoveler, Pink-eared Duck, Hardhead and Musk Duck at Donnybrook Road Lake.** The lake is north of Donnybrook Road, 2 km east of Donnybrook. Twenty-one waterbird species composed of thirteen species of waterfowl (203 birds) and eight species of waders (13 birds) were present on the lake on 28 May 1991 (Martin Schulz pers. comm.). The lake supports extensive submerged herbfields of Blunt Pondweed permanent wetland (26.1). The substantial populations of waterfowl suggest that other species such as Fennel Pondweed or Many-fruit Tassel may be present. Waterfowl recorded in May 1991 included 7 Australasian Grebe, 18 Hoary-headed Grebe, 45 Eurasian Coot, 16 Australian Wood Duck, 3 Black Swan, 22 Pacific Black Duck, 37 Grey Teal, 5 Chestnut Teal, 8 Pink-eared Duck, 8 Hardhead, 25 Australian Shelduck, 3 Musk Duck and 6 Australasian Shoveler. This is comparable with the highest waterfowl population densities recorded on the plains of NEM (see sites 12 and 39). The autumn of 1991 was very dry and the lake provided an important waterbird 'drought refuge'.
- Ee* **4^a: Brown Quail, Buff-banded Rail, Latham's Snipe and Striated Fieldwren of the plains grassland meadows.** One quail, two rails, two snipe and two Striated Fieldwren were observed in a stand of Common Tussock-grass plains grassland (23.1) in floodplain freshwater meadow near the junction of Bald Hill Creek and Merri Creek on 14 November 1989. Five snipe had been recorded in the same locality on 18 October 1988.
- Ee* **4^a: Rainbow Bee-eater.** Eight birds were investigating the banks of Bald Hill Creek at Hillside in preparation for nesting on 18 October 1988. The vegetation is River Red Gum (plains) drainage line woodland (30.1).
- Ee* **4^a: White-winged Triller, Rufous Songlark and other River Red Gum woodland birds.** The site supports a higher diversity of grassy woodland species (e.g. birds of prey and tree hollow nesting parrots) than other sites along the Merri Creek. The stand of River Red Gum grassy woodland (14.1) to the east of the Merri Creek in the northern corner of Braelands contains a number of faunal species that would be otherwise absent. These include the Tawny Frogmouth (caught in a bat trap on 1 March 1989), Crimson Rosella (4 June 1990), Gang-gang Cockatoo (seven birds on 3 March 1989), White-winged Triller (nesting on 14 November 1989), Rufous Songlark (nesting on 18 October 1988), Little Wattlebird and Pied Currawong (4 June 1990). The rosella, cockatoo and currawong are autumn–winter visitors from forests of the Eastern Uplands. The wattlebird, which is uncharacteristic of red gum woodlands, was a wandering juvenile seen on 3 March 1989.

Mammals

- Eb* **4^a: Inland Broad-nosed Bat.** Two were trapped in Woolly Tea-tree riparian scrub (18.2) along the Merri Creek at the boundary of Braelands and Merriang Park between 1 and 3 March 1989. The bat trap had been placed in 1 m of water in a pool under an overhanging River Red Gum. This bat, which is characteristic of the River Red Gum plains of the Murray Valley, had not been recorded in southern Victoria before this study. The Plenty Valley provides the range limits for the related Inland Broad-nosed Bat and Eastern Broad-nosed Bat and is one of their nearest known approaches in habitat and range.

The Inland Broad-nosed Bat occurs in lower annual rainfall areas (500–640 mm) than the Eastern Broad-nosed Bat (640–700 mm) in GM. Both species are largely confined to watercourses. The Eastern Broad-nosed Bat is restricted to the alluvial plains (habitats 5.1, 5.3, 14.3 and 16.4) while the Inland Broad-nosed Bat is restricted to the volcanic plains (habitats 14.1, 14.8, 16.2 and 18.2, 30.1).

- Ec* **4^a: Fat-tailed Dunnart.** Several nests were located amongst friable brown uniform clay loams under rocks in Kangaroo Grass stony knoll grassland (22.1) during the survey.

4^a: Uncommon plains mammals. Echidnas, Common Wombats, Eastern Grey Kangaroos and Black Wallabies range the remote sections of the creek. Populations enter the site from the Great Divide through habitat links in the upland hills (Eden Hills site).

Butterflies

4^a: Merri Creek east of Bald Hill. Butterfly searches were conducted on 18 October 1988 and 1 March 1989 along the creek to either side of the Gas and Fuel pipeline crossing. Thirteen native, non-migratory species were recorded. An emergence of over 50 Small Coppers was seen on 18 October 1988. This species has declined on the volcanic plains and was not recorded elsewhere in NEM in these numbers. There was also a Caper White migration occurring on 18 October 1988. This species originates from central and northern Australia. Large numbers appear every five to 10 years in southern Australia after good inland breeding seasons. The Caper Whites passed through for much of the day at 1–2 m above the ground. Eastern Ringed Xenicas were also seen at this time. They are rare on the volcanic plains. Several Symmomus Skippers and one Klugs Xenica were observed on 1 March 1989. Larvae of the Symmomus Skipper are reared on Spiny-headed Mat-rush which grows on the creek escarpments. The skipper is rare on the volcanic plains.

Freshwater fish

4^a: Electrofishing Survey: Merri Creek—above rail bridge 3 km north-east of Kalkallo

Map reference. 7822 219462. **Altitude.** 250 m. **Survey date.** 1 February 1989

Vegetation. Instream: submerged and emergent herbfield (fair condition; 10% cover of algae). Bank: Woolly Tea-tree riparian scrub (18.2; fair condition). Frontage. Lightwood–Tree Violet cliff/escarpment shrubland (20.5; poor condition; weeds include Gorse, African Box-thorn, Sweet Briar, Fennel and Montpellier Broom); Common Tussock-grass plains grassland (23.1; fair condition).

Physical Features:

Pools

Substrate. Deep silt, logs and basalt boulders and cobbles on basalt base

Maximum size (mid-summer). 6 m wide by 2.0 m deep by 50 m long

Riffles

Substrate. Basalt boulders and cobbles on basalt base and sections of tessellated pavement

Flow (mid-summer low): **Size.** 0.5 m wide by 2 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.5 ML/day

Water quality

Summer: Temperature. 19.0°C. **Conductivity.** 460 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (2); migratory sub-adult. Freshwater Blackfish (1); likely breeding resident

Alien species numbers/status. Goldfish (8); likely breeding resident. Mosquito Fish (3); likely breeding resident

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Intact riparian habitat link south to the Kalkallo–Donnybrook North Rail Reserve site. This then links the Craigieburn to Donnybrook and Craigieburn Grassland sites. Partially intact links occur north to the Beveridge Rail Reserve site. Links south-east along the Darebin Creek to the Fenwick and Surrounds site are virtually severed.

Broad-acre farm subdivision, loss of cover due to livestock grazing/rock clearing and fox predation. These are each substantial threats to the Southern Lined Earless Dragon in GM. Urban encroachment and subdivision of broad-acre farms into farmlets has eliminated most known sites of the dragon. Each of the four known surviving populations is small and fragmented and at risk of elimination through further habitat loss and degradation. Over recent years the habitat of the Earless Dragon along the Merri Creek in the Bald Hill site has been heavily grazed by sheep and the grassland cover has been reduced to rocks and bare ground. Fox populations in the area have increased and the dragon has not been located since it was first observed in 1988. It appears unable to persist under heavy grazing due possibly to food and cover loss and the associated increased risk of predation.

The dragon was located along the Merri Creek in the Bald Hill site in a remote corner of three adjoining broad-acre farms. Intense livestock grazing (mostly sheep) has occurred on two of these properties over the last decade. This has removed most of the shrub layer vegetation (particularly during droughts).

Farm management intensification/pasture improvements. Farmlet subdivision of broad-acre grazing land within or adjacent to the site will reduce faunal values. Concomitant with farm intensification has been an increase in levels of livestock grazing and loss or modification of native grasslands through pasture 'improvements' including rock removal, cultivation and application of fertilisers, pesticides and herbicides. Several stands of grassland and freshwater meadow were undergoing cultivation when last visited in June 1991.

Lack of regeneration of River Red Gums and shrubs. Regeneration has been prevented by livestock.

Earless Dragon management/critical habitat nomination. The Merri Creek and a strip to either side extending 200 m for the length of the site is proposed as the Earless Dragon Critical Conservation Area in NEM. Despite recent land degradation, sections of grassland protected from grazing by fencelines are relatively intact. The Earless Dragon is the rarest and probably most habitat-dependent and specialised plains grassland reptile. The future viability of remaining populations is dependent on the retention and enhancement of rocky grassland habitat and habitat links. Management should include restrictions on clearing, cultivation, rock removal and excessive grazing of rocky grassland and predator (particularly fox) and rabbit control. Active conservation management for this endangered species is required otherwise its regional and national extinction may result.

Strengthen habitat links. Conservation management of the site as a habitat link is critical for the movement of fauna in the Merri Creek valley. The long-term viability of faunal populations at Craigieburn Grassland depend on protecting upstream native grassland habitat links.

Native vegetation/rock clearance controls. With the exception of approved extraction permit areas, these need to be enforced to protect one of the last known localities of the endangered Earless Dragon.

Require land-use and conservation plans for land protection works. These should outline appropriate land management from protection of existing values through to habitat enhancement programs such as weed and predator control and revegetation.

Grazing exclosure zones under River Red Gums/regeneration. Stock should be excluded by fencing from sections (preferably all) of the stand of River Red Gums on the plains to the east of the Merri Creek to enable natural regeneration.

Declining water and habitat quality of the Merri Creek. Where stock gain access to the creek, native riparian vegetation has been depleted and weed invasion, bank erosion and water pollution is occurring. When surveyed between the late 1980s and early 1990s, the Braelands property on the east/south side of the Merri Creek was being chronically overgrazed by sheep. Native shrubland vegetation was severely depleted and River Red Gums were dying from salinity related causes. The water temperature of the creek was relatively high, influenced by ineffective riparian vegetation cover and lack of summer stream flow. This was the result of timber clearing and damming in the catchment and draining of swamps, such as Hernes Swamp, which held back the winter runoff and fed the stream through gradual seepage over summer.

The upstream sewage treatment plant may eliminate the Freshwater Blackfish, as summer flow is mainly treated effluent. Nitrogen/phosphorous enrichment has resulted, contributed to by livestock. Algal blooms during summer have caused severe oxygen depletion and eutrophication of the water.

Streamway livestock exclusion zone. A high priority is the provision for natural regeneration of riparian and escarpment vegetation along the creek. Adequate fencing should be provided for a set-back of at least 100 m from both creek escarpments to contain adjacent stony crests and stony plains. These support the Red-chested Button-quail.

Reduce grazing levels in freshwater meadows on west side of creek. The low-lying meadows (containing the cover-dependent Brown Quail, Buff-banded Rail and Latham's Snipe) need to be protected from livestock grazing. Grazing should not occur during winter-spring when damage to the soft substrates and herbfields occurs.

Monitor/improve water quality of creek. Water quality tests, particularly for salinity, nitrates and *E. coli* need to be conducted at all six electrofishing sites (and additional sites at Barry Road and Bell Street) along the Merri Creek. Streamway management that will improve the water quality and protect the Freshwater Blackfish is urgently required.

Other Issues

Bluestone quarry proposal. Much of the significant grassland area of the site is owned or leased by Boral Australia. An application for rock extraction license is being considered subject to the presentation of an acceptable conservation management plan by Boral Australia which follows environmental guidelines required under the Mineral Resources Development Act. Issues relating to application of the Flora and Fauna Guarantee, in particular impact on threatened flora and fauna species, are being considered by the Department of Natural Resources and Environment. Boral Australia has provided a consultant flora study by Bosis Australia and sponsored a trapping/assessment survey for the Southern Lined Earless Dragon by NRE. Approval for mining will be subject to successful application to Council for a planning permit under the Local Government Planning Scheme.

Montpellier Broom along the Gas and Fuel pipeline. The broom appears to have been brought in by installation earthworks. Spread of the broom is partly controlled by the intensive sheep grazing regime. Without immediate eradication, the weed has the propensity to over-run the area if a streamway livestock exclusion zone is erected.

Conservation incentives to landowners. These will be required to achieve many of the habitat enhancement objectives.

Require intensive flora/fauna studies.

Land protection works required by Gas and Fuel Corporation. The Gas and Fuel Corporation needs to remove Montpellier Broom and other weeds such as Gorse and Serrated Tussock which have established as a result of soil disturbance along the path of the gas pipeline. Removal will need to be by contact spraying or hand. Monitoring of any re-establishment of these weeds should be undertaken.

Site 5 Kalkallo–Donnybrook North Rail Reserve

- Map Reference:** 7822 193443 (Kalkallo Common); 7822 193441 (Kalkallo Cemetery); 7822 196429 to 7822 214462 (Merri Creek); 7822 208435 to 7823 227507 (railway reserve from 400 m north of Donnybrook station to Beveridge Lane). One minute lat/long grids include 37° 28' x 144° 59', 37° 29' x 144° 58' to 144° 59', 37° 31' x 144° 57' to 144° 58' and 37° 32' x 144° 57' to 144° 58'.
- Location/Size:** Kalkallo–Donnybrook and the Merri Creek upstream to the NE Railway bridge and the NE Railway reserve from the Donnybrook mineral springs to Beveridge Lane. Approximately 400 ha.
- Municipality:** Shire of Mitchell and City of Whittlesea (east of NE Railway).
- Land Tenure/Use:** Public: Kalkallo Common (NRE); V Line Reserve along the NE Railway; and Kalkallo Cemetery (Shire of Mitchell). Private: vacant blocks on the fringe of Kalkallo township and farmland. The common is occasionally agisted for livestock grazing (generally horses). Farmlets near Kalkallo and Donnybrook and broad-acre farms of sheep and cattle in the north.
- Landforms:** Volcanic plain (see MUVB B). Elevation is 220–240 m.

Natural Heritage Values

Landscape. The Kalkallo Common/Kalkallo Cemetery is the most extensive and intact area of gilgai plain on public land in NEM and one of the most intact remaining on the volcanic plains of GM. It is representative of a formerly widespread volcanic plains landscape that has been virtually eliminated. It should receive priority protection and conservation management.

Scientific and Educational Values

Invertebrates. Freshwater crayfish (*Engaeus quadrimanus*) at electrofishing site

Scientific reference. Electrofishing site and instream reference point on the Merri Creek below rail bridge 2 km north-east of Kalkallo.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 3

Reference stands: Kangaroo Grass plains grassland (23.2; Kalkallo Common); Brown-back Wallaby-grass seasonal wetland (25.3; Kalkallo Common)

Partially intact or small stands: River Red Gum (plains) drainage line woodland (30.1; Kalkallo Creek); Woolly Tea-tree riparian scrub (18.2); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); Swamp Gum swampy woodland (27.1)

Endangered species (presumed extinct): Small Pepper-cress (west side of the NE Railway about 200 m south of Beveridge Lane; last seen in November 1986 now overgrown by weeds due to rail disturbance); *Prasophyllum* sp. aff. *frenchii* (undescribed and endangered volcanic plains orchid last seen in November 1986 on the east side of the line about 1 km south of Beveridge Lane; eliminated by rail management access track)

Rare species: *Agrostis aemula* var. *setifolia*, Pale Swamp Everlasting, Slender Tick-trefoil

Critical assemblages or populations: Gilgai Plains Grassland Critical Conservation Area (Kalkallo Common/Cemetery). This area contains the most intact example of gilgai plains grassland in NEM. This consists of Kangaroo Grass plains grassland at the cemetery (the only remaining in GM with a shrub-pea stratum) and higher ground on the common and Brown-back Wallaby-grass seasonal wetland in low-lying gilgais on the common. Such intact examples of plains grassland/seasonal wetland are rare on the volcanic plains. A

small stand of stony knoll grassland on private land south of Kalkallo Cemetery supports the VROT Slender Tick-trefoil and regionally vulnerable Pussy-tails and Narrow-leaf New Holland Daisy. The regionally vulnerable Chaffy Bush-pea and regionally depleted Smooth Rice-flower occur at Kalkallo Cemetery.

FAUNAL SIGNIFICANCE : Site 5 Kalkallo–Donnybrook North Rail Reserve

Assessment: Regional—Category 2 (B, C, D, E, F)

Reference grids for the significance keys include:

5^a: 37° 28' x 144° 59'; North East Railway–Donovans Lane to Beveridge Lane

5^b: 37° 31' x 144° 57'; Kalkallo Common/Cemetery

5^c: 37° 31' x 144° 58'; Merri Creek north-east of Kalkallo

5^d: 37° 32' x 144° 57'; Merri Creek north of Donnybrook

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 5^b: Red-chested Button-quail (Kalkallo Common on 10 January 1990)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Local. 5^b: 5 species including the Plains Froglet and Common Spadefoot Toad at Kalkallo Common on 31 May 1991

l. Reptiles

Regional. 5^c: 8 species including the Eastern Three-lined Skink, Southern Water Skink and Bougainville's Skink from the Merri Creek electrofishing site and surrounding stony crests, 2 km north-east of Kalkallo on 20 September 1988

Regional. 5^b: 7 species including the Cunningham's Skink, Bougainville's Skink, Eastern Three-lined Skink, Little Whip Snake and Lowland Copperhead from a 2-hour search of the stony crests and rises south of Kalkallo Cemetery on 14 January 1992

m. Freshwater fish

Regional. 5^c: 2 species (2 Short-finned Eel and 3 Australian Smelt) at the Merri Creek electrofishing site 2 km north-east of Kalkallo on 20 September 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Local. 5^d: 42 species. **5^b**: 30 species

c. Native mammals

Local. 5^b: 2 species: Echidna and Eastern Grey Kangaroo at Kalkallo

d. Herpetofauna

Regional. 5^b: 15 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 5^b: 2 species. **5^{cd}**: 1 species

b. Regionally endangered fauna (R1 species)

Regional. 5^b: 1 species. **Birds**: Red-chested Button-quail

c. Regionally vulnerable fauna (R2 species)

Regional. 5^c: 1 species. **Fish:** Australian Smelt

d. Regionally rare fauna (R3 species)

Regional. 5^b: 1 species. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Local. 5^d: 1 species. **Birds:** Striated Fieldwren

f. Regionally restricted fauna (R5 species)

Regional. 5^b: 9 species. **Birds:** Cattle Egret, Brown Songlark, Singing Bushlark. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

Regional. 5^c: 8 species. **Birds:** Purple-crowned Lorikeet, Brown Songlark. **Mammals:** Water Rat. **Reptiles:** Large Striped Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

Local. 5^d: 4 species. **Birds:** Cattle Egret. **Reptiles:** Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

f. Frogs

Regional. 5^b: Over 50 Plains Froglets and 30 Ewing's Tree Frogs calling at Kalkallo Common on the evening of 14 November 1989. Recent heavy rains had inundated the gilgais in the common. A chorus of over 100 Common Spadefoot Toads was heard at the common on 17 May 1989. This was the largest number encountered in NEM during the survey

g. Rare/restricted colonial fauna

Regional. 5^d: 30 Cattle Egrets, 10 Straw-necked Ibis and 100 Australian White Ibis in the paddocks along Donnybrook Road near the Merri Creek on 4 June 1990

m. Regionally rare fauna (R3 species)

Regional. 5^b: over 50 Plains Froglets at Kalkallo Common on 14 November 1989 (see *Ff*)

Outlook

The faunal significance will decline under present management as the habitat links to the common/cemetery have been severed by housing at Kalkallo to the west and by rock-picking to the east. With management the faunal significance of ground fauna at the common would increase.

FAUNA

Rare or Threatened Fauna

Bc 5^b: Red-chested Button-quail at Kalkallo Common. One seen along with several Stubble Quail in Kangaroo Grass plains grassland (23.2) on 10 January 1990. The preceding months had been wet and the common remained ungrazed during spring. The button-quail requires dense grassland cover. Livestock grazing conducted at the common in 1991 and 1992 in combination with lack of cover resulting from successive years of low rainfall over late summer–early autumn prevented the button-quail from revisiting the area. Searches should be conducted for the Plains-wanderer at the common.

Other Significant Fauna

Birds

Ef 5^c: Purple-crowned Lorikeet in River Red Gums along the Merri Creek. The Purple-crowned Lorikeet, Red-rumped Parrot and Restless Flycatcher were recorded in Woolly Tea-tree riparian scrub (18.2) at the electrofishing site on 20 September 1988.

5^b: Common Bronzewing. One observed foraging amongst Gorse thickets in Kangaroo Grass stony knoll grassland (22.1) south of Kalkallo Cemetery on 31 May 1991. The bronzewing is a rare winter visitor to this section of the Merri Plains.

Mammals

Ef **5^c: Water Rat.** One at the electrofishing site, 2 km north-east of Kalkallo on 20 September 1988.

5^b: Eastern Grey Kangaroo. Two present in Kangaroo Grass stony knoll grassland (22.1) south of Kalkallo Cemetery on 14 January 1992.

Frogs

Ed **5^b: Plains Froglet at Kalkallo Common.** This species calls in late winter and spring. Over 50 were chorusing in mid-November 1989 after heavy rains.

Ef **5^b: Common Spadefoot Toad at Kalkallo Common.** In wet years when the gilgais are inundated and the grasslands are saturated, large choruses of the Common Spadefoot Toad are heard at the Kalkallo Common. It calls on rainy nights from mid-autumn to mid-winter. Over 100 were chorusing on 17 May 1989. The spadefoot toad is widespread but uncommon on the Merri Volcanic Plains. It is abundant only in relatively unmodified areas. The larval stage is rapid and adults breed in the temporary water in the roadside table drains and gilgais in wet years. The spadefoot toad is adapted to the lower and less reliable rainfall patterns and ephemeral wetlands of the inland plains of Victoria. The range extends into southern Victoria through the Kilmore Gap. The spadefoot toad is a burrowing species adapted to loose soils. It may have declined elsewhere due to ground compaction caused by hooved animals. The draining of ephemeral wetlands has been a further limiting factor.

There are relatively low numbers of Common Bullfrogs and Spotted Marsh Frogs at Kalkallo Common as these have long development periods requiring permanent water. They are common elsewhere and have benefited from the establishment of dams. Cattle Egrets, White-faced Herons and ibis frequent the common in wet winters, attracted by frogs and invertebrates such as land yabbies in the gilgais. This gives rise to the term ‘crab-holes’ given to the gilgais by farmers.

Ef **5^b: Reptiles of the stony knoll grassland south of Kalkallo Cemetery.** The Kangaroo Grass stony knoll grassland (22.1) supports the Large Striped Skink, Cunningham’s Skink, Bougainville’s Skink, Tussock Skink and Little Whip Snake. The area contains suitable habitat for the Striped Legless Lizard. A pitfall trapping survey is recommended.

5^d: Habitat link in both directions along the streamway for herpetofauna. The Merri Creek at Donnybrook connects significant areas of volcanic plains grassland habitat to the north and south. The creek and its escarpments contain a relatively high density of herpetofauna species. Eight reptile species were taken in a 1-hour herpetofauna search at the electrofishing site. The Southern Water Skink and Growling Grass Frog were common along the creek. Only small areas of habitat suitable for the Earless Dragon (recorded in the adjoining Bald Hill site) and the Striped Legless Lizard (recorded in the adjoining Craigieburn to Donnybrook site) remain in the site. Ground fauna searching/trapping should be conducted for these species.

Freshwater fish

Ec **5^c: Australian Smelt.** Three were electrofished and another dozen were seen in the Merri Creek about 1 km below the railway bridge on 20 September 1988. This is one of only two of the 52 electrofishing sites in NEM in which the species was recorded. It is moderately common in the Yarra River. The apparent absence of the migratory Common Galaxias indicates that the weir (prior to construction of the fish-way in 1993) at Dights Falls on the Yarra River, which is below the confluence of the Merri Creek, restricted their movements. Large populations of Mosquito Fish and Goldfish were present. The future survival of the Australian Smelt in the Merri Creek is insecure given the recent commission of the upstream Wallan sewage treatment plant.

5^c: Electrofishing Survey: Merri Creek—below rail bridge 2 km north-east of Kalkallo

Map reference. 7922 209449. **Altitude.** 230 m. **Survey date.** 20 September 1988

Vegetation. Instream: submerged and emergent herbfield (fair condition). Bank: Woolly Tea-tree riparian scrub (18.2; fair condition). Frontage: Lightwood–Tree Violet cliff/escarpment shrubland (20.5; poor

condition; alien shrubs include Gorse, African Box-thorn, Sweet Briar, Fennel and Montpellier Broom and alien herbs include Yorkshire Fog, Spanish Artichoke, Spear Thistle and Chilean Needle-grass); Kangaroo Grass stony knoll grassland (22.1; poor condition).

Physical Features:

Pools

Substrate. Deep silt and basalt boulders on basalt base

Maximum size (early spring). 6 m wide by 1.5 m deep by 40 m long

Riffles

Substrate. Basalt boulders and cobbles on basalt base and sections of tessellated pavement

Flow (early spring high): Size. 3.0 m wide by 20 cm deep. **Velocity.** 0.6 m/sec. **Rate.** 85 ML/day

Water quality

Spring: Temperature. 13.0°C. **Conductivity.** 360 ms. **Turbidity.** Muddy floodwaters

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (3); migratory sub-adult. Australian Smelt (3 electrofished and an additional 12 seen); likely breeding resident

Alien species numbers/status. Goldfish (9); likely breeding resident. Mosquito Fish (2); likely breeding resident.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. The Merri Creek forms a partially intact habitat link between the Bald Hill site and the Craigieburn to Donnybrook site. Kalkallo Common lacks effective habitat links.

Strengthen habitat links. The creek section of the management unit is partially degraded but directly links the Craigieburn to Donnybrook site with the Bald Hill site and forms an integral component of the Craigieburn Grassland to Bald Hill habitat link. Faunal conservation of both sites requires protection and enhancement of this section of the link. Streamway conservation management would protect biological values within the stream and support those of the adjoining significant sites.

Farm intensification and pasture improvements, rock clearing, grassland cultivation. Subdivision of broad-acre farms into farmlets is occurring along with farming intensification. This includes increased levels of livestock grazing and loss or modification of native grasslands through pasture 'improvements' including rock removal, cultivation, sowing pasture species and application of fertilisers, pesticides and herbicides. Most of the farmlets adjoining the southern section have been heavily rock-cleared. Extensive loss of native grassland associated with the subdivision has occurred, substantially lowering the biological significance and habitat link utility, particularly for ground fauna.

Land protection and conservation of links between Kalkallo Common and the Merri Creek. This refers to private land such the stony knoll grassland south of Kalkallo Cemetery and rock-picked farmland to the east of the common. The conservation status of areas between the common/cemetery and the Merri Creek has declined due to rock removal, grassland degradation and heavy livestock grazing. This has isolated the grasslands at the Kalkallo Common from those adjoining the Merri Creek. Areas of conservation significance should be identified and protected. Reptile populations at Kalkallo Common/Cemetery are now isolated from populations along the Merri Creek. Many of these species, in particular the Striped Legless Lizard, if present, will need conservation management if they are to persist. Incentives and information should be provided to landowners to conduct these works.

Urban encroachment. The site lies close to urban development areas at Donnybrook and Kalkallo. House blocks to the west of the site at the fringe of Kalkallo are being developed.

Loss of native grassland at Kalkallo Cemetery. In recent years there has been a substantial increase in the number of burials at the cemetery. The area is large but new burials are occurring in the significant grassland area on the north side, despite extensive areas of degraded grassland present on the south side. The grassland is closely slashed in spring–summer.

Conservation buffer zone from Kalkallo township. A ‘buffer zone’ plan to protect the biological values of the Kalkallo Common/Cemetery from residential areas to the west should be developed.

Gilgai Plains Grassland CCA and designation of Kalkallo Common as a grassland reserve. The Kalkallo Common and Kalkallo Cemetery is the designated Critical Conservation Area for gilgai plains grassland habitats in NEM. Protection and conservation management is urgently required (i.e. arrangement with the cemetery trust over the grassland to the north and east of the grave sites and with NRE over the Kalkallo Common.

The Kalkallo Common should be managed for nature conservation:

- Land protection activities and other aspects of conservation management need to be urgently upgraded. The common has excellent nature conservation potential and contains rare habitats and landscapes that are unreserved in NEM.
- A rationalisation of the stock agistment policy is required.
- Rare plant, waterbird, frog and quail conservation requires the cessation of grazing. If grazing were excluded from the common additional rare seasonal wetland birds which are dependent on cover may utilise the meadows. These include the Little Button-quail, Australasian Bittern, Latham’s Snipe, Buff-banded Rail, Brown Quail and Striated Fieldwren.
- A perimeter slash break along the road boundaries may be necessary for fire prevention.
- Replanting of seasonal wetland herbs including the Plains Yam-daisy could be undertaken.
- The significant grassland on the northern side of the cemetery needs to be protected from further burials. This area supports the only population of the regionally vulnerable Chaffy Bush-pea known to remain on the volcanic plains of GM. Possibly other rare grassland species are present but grass slashing has limited the opportunity to survey the area. Grass slashing should be restricted to areas adjoining the graves.

Creek degradation including earthworks and weed invasion. Several dams occur along the creek. The creek bank has been degraded by earthworks and livestock trampling and grazing. This has enabled heavy infestations of several alien plant species including Toowoomba Canary-grass, Gorse and African Box-thorn.

Declining water quality of creek.

Electrofishing site. Extensive rock clearing has occurred on the property west of the creek. Upstream was a dam formed of basalt boulders (water/fish can pass through). Bank erosion—slumping of upper escarpments from livestock grazing.

Merri Creek streamway works. A high priority is the provision by stock exclusion for natural regeneration of the riparian herbfields and shrublands and River Red Gums along the creek. Adequate fencing should be provided for a set-back of at least 100 m from both creek escarpments to contain the adjacent stony crests. See the Craigieburn to Donnybrook site.

Implementation of Native Vegetation Clearance Controls on private land. Controls should be placed on any further land clearing or earthworks near the creek. Further removal of outcropping rock should be prevented.

Other Issues

Public land disposal and inadequate conservation of Kalkallo Common. Disposal of the common by the Victorian Government is a possibility, despite the designated very high biological and landscape values. The Kalkallo Common is at times heavily grazed by livestock and structural damage to the soil and loss of seasonal wetland herbs (e.g. Plains Yamdaisy) caused by trampling and grazing of the herbfield has occurred. Over 10 horses are frequently present. Grazing damage on the common has largely occurred from May to December due to the fragility of the herbfield and substrate when they become damp or inundated.

Weeds, rabbits and foxes on stony knoll grasslands and shrublands. The stony knolls and creek escarpments have become heavily infested with Gorse, Sweet Briar and Spanish Artichoke. Chilean Needle-grass dominates sections of heavily/cultivated low-lying land on the creek flats. Foxes and rabbits are common amongst the gorse and have dramatically increased over the last three years.

Require a flora and fauna survey. An intensive flora and fauna survey, particularly specific surveys for the Plains-wanderer and Striped Legless Lizard, is required for the Kalkallo Common/Cemetery and private land to the south of Kalkallo Cemetery. The creek and rail reserve section also require a flora survey. This area has only been briefly surveyed for fauna. Herpetofauna trapping should be conducted for the Striped Legless Lizard. Detailed searches for the Southern Lined Earless Dragon should be conducted along the rocky escarpments, particularly where continuous bands of stony rises extend from the creek. A waterbird survey along the creek may reveal additional significant species (e.g. Latham's Snipe, Lewin's Rail and Spotless Crane).

Require land protection activities. Weed and vermin control on the stony knolls is a major priority. The Gorse brings some native fauna species (e.g. Common Bronzewing and Eastern Grey Kangaroos) into the site. Before weedy shrubs are removed from the stony knolls a plan for revegetation with comparable native species such as Tree Bursaria, Tree Violet, Drooping Sheoke and Tree Banksia should be developed.

V Line management and associated threatening processes on rail reserves

V Line rail management activities leading to weed invasion. Grassland remnants along the North Eastern Railway are being removed by rail maintenance, firebreak ploughing, herbicide spraying and dumping of ballast. Disturbed areas are now dominated by introduced weeds including Wild Oat, Paspalum, Toowoomba Canary-grass, Ox-tongue, St John's Wort, Yorkshire Fog and brome grasses and vermin including the Black Rat, rabbit and slugs.

Ongoing destruction of rail reserve grasslands. Swampy woodland and grassland remnants along the North Eastern Railway have been removed by rail maintenance activities. Grassland habitat along the east side of the line between Donovans Lane and Beveridge Lane was cleared and degraded in about 1984 by the installation of an access track/grader strip (presumably for track maintenance and fire protection purposes). Embedded rocks were bulldozed into piles which then became the dumping area for ballast and rubble from elsewhere along the line. These loose rock piles now form habitat for introduced Black Rats, rabbits and slugs. Disturbed areas are now dominated by introduced weeds. Few reptile species now inhabit the disturbed sections of the railway reserve. A dense introduced grassland sward has developed along the disturbed strips which necessitates ongoing annual fire prevention works such as grading (see Merri Creek Beveridge to Wallan unit).

Elimination of two endangered plant species along the rail reserve south of Beveridge Lane.

The earthworks and weed invasion eliminated a small stand of the Small Pepper-cress which grew on the western side of the line. It occurred on friable brown duplex soil on a stony crest. These activities also eliminated the last known population of an undescribed and presumably extinct 'volcanic plains' leek-orchid (*Prasophyllum* sp. aff. *frenchii*; affinity Slaty Leek-orchid). A single plant was located in 1983 on the east side of the line some 500 m south of Beveridge Lane on heavy black clay soil (Neville Scarlett pers. comm.). This plant was eliminated the following year by a grader strip for an access track. The area was searched in several subsequent years by the author. One plant was located in November 1986 about 500 m further south in a swale near another drainage line. Sporadic plants still possibly occur but the grader strip occurs along the fenceline for the entire length of the narrow reserve south to Donovans Lane. The railway reserve from Donovans Lane to Beveridge Lane should be searched annually. In the event that a further plant flowers, seed could be obtained for *ex situ* germination.

MERRI LOWLAND VOLCANIC PLAINS (MLVP)

Farmland and urban catchments of the middle and lower Merri Creek and Edgars Creek.

Land use

Past land use: pastoral and township. Present: pastoral (in the north), farmlets, townships, urban (in the south), rock extraction and recreation (e.g. Edwards lake).

Native vegetation cover

Extensive in the north, highly fragmented in the south.

Key biological features

The most significant species are the Brown Quail, Red-chested Button-quail, Little Button-quail, Plains Wanderer, Banded Lapwing, Latham's Snipe, Spotted Harrier, Swamp Harrier, Black Kite, Black Falcon, Budgerigar, Striated Fieldwren, Diamond Firetail, Zebra Finch, Fat-tailed Dunnart, Southern Lined Earless Dragon, Striped Legless Lizard, Red-bellied Black Snake, Matted Flax-lily, Plains Flax-lily, Swollen Swamp Wallaby-grass, River Swamp Wallaby-grass, Water Starwort, Curly Sedge, Small Milkwort, *Agrostis aemula* var. *setifolia*, Dusky Scurf-pea and Tough Scurf-pea.

The most significant habitats are grassy woodland, cliff escarpment shrubland, riparian scrub, stony knoll grassland (particularly Craigieburn Grassland), plains grassland, drainage line herbfield and seasonal wetlands (particularly O'Herns Road Wetlands).

Of particular note are the faunal rarity, abundance and diversity (particularly quail, birds of prey, reptiles and waterbirds) and habitat rarity, abundance and diversity, a volcanic plains ecological reference area, and volcanic plains strategic habitat link (particularly Merri Creek).

Key areas and physical features for biota

Merri Creek and surrounds, Craigieburn Grassland, O'Herns Road Wetlands, Cooper Street Grassland, Hendon Park and Bunker Hill Swamp/Boonderoo.

There are nine sites of significance: one national, five state and three regional for fauna and three very high, five high and one medium for habitat.

MLVP A MERRI CREEK CLIFTON HILL TO CAMPBELLFIELD

This Management Unit consists of two sites of regional faunal significance (sites 6 and 7).

Map Reference	7922 232161 to 7822 201263 (Merri Creek); 7822 215215 to 7822 231245 (Edgars Creek).
Location/size	Merri Creek from Heidelberg Road to Mahoneys Road and Edgars Creek from Merri Creek to Broadhurst Avenue including Edwardes Park Lake. Approximately 400 ha.
Municipality	Cities of Darebin, Hume and Moreland.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands at the boundary of the alluvial plains to the east. The land surface to the east of Edgars Creek is sandstone and to the west is basalt.

An area between Fawkner and Campbellfield was low-lying in the Tertiary period. The yellow sands and white clays towards Campbellfield are lake deposits, the result of deposition from an extensive lake system in the early Tertiary. This may have been connected with the Tertiary river alluvium between Janefield and Kangaroo ground (perhaps the estuary of the ancient river called 'Wurundjeri'). During the late Tertiary the Fawkner area was covered by a sea, depositing the red sands.

Landforms

Stony crests, stony plains, gilgai plains, sand-crests, plain-slopes (east of Edgars Creek and east of Merri Creek downstream of the confluence with Edgars Creek), creeks and an artificial lake. Merri Creek contains sections of gorge with columnar basalt and sedimentary cliffs, boulder screes and rocky escarpments, fast-flowing riffle sections of basalt cobbles and tessellated basalt pavement and sections of sedimentary reef and slow-flowing open pools. Elevation is 15–90 m.

Hydrology

Merri creek is perennial and contains deep, reed-lined pools and fast-flowing riffles. Some of the pools exceed 2 m in depth. Edgars Creek is a perennial stream fed over the summer months primarily by urban runoff. It was formerly a small perennial brook, fed from springs near its headwaters along Craigieburn Road East. The course of most of the creek from downstream of Lalor has been channelled and the escarpments have been re-shaped. Edwardes Lake is the largest waterbody in the northern suburbs of Melbourne. It is an artificial impoundment of about 10 ha and 1.5 m average depth.

Rainfall: 620–640 mm.

Site 6 Heidelberg Road to Normanby Avenue

Merri Creek valley and immediately adjoining open space and residential and industrial land from Heidelberg Road Clifton Hill to Normanby Avenue Thornbury. The electrofish data was taken from Raadik (in prep.). This site lies outside the area covered by the five NEROC councils but lies within the study area of North East Melbourne. Systematic bird and reptile survey was conducted in the management unit. Due to time and contractual constraints the site has not been fully written up. Summary keys on habitat and faunal significance and the fauna lists are presented. The management unit and site boundaries are shown on Map 1. This will enable comparisons with NEROC sites in the Merri Lowland Volcanic Plains. Relevant management issues for site 6 are discussed under the Regional Hydrological Strategy (Volume 1) and Regional Habitat Link Strategy (Volume 1). Refer to site 34 for text on the Large-footed Myotis and site 36 for text on the Common Galaxias.

Map Reference: 7922 242161 to 7822 220190 (Merri Creek from Heidelberg Road to Normanby Avenue). One minute lat/long grids include 37° 45' x 144° 59', 37° 46' x 144° 59' and 37° 47' x 144° 59'.

Municipality: Cities of Darebin and Moreland.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 3

Partially intact or small stands: Woolly Tea-tree riparian scrub (18.2); Lightwood–Tree Violet cliff/escarpment shrubland (20.5)

FAUNAL SIGNIFICANCE: Site 6 Heidelberg Road to Normanby Avenue

Assessment: Regional—Category 2 (B, C, D, E)

Reference grids for the significance keys include:

6^a: 37° 46' x 144° 59'; Merri Creek, St Georges Road to Normanby Avenue

6^b: 37° 47' x 144° 59'; Merri Creek, upstream of Queens Parade

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 6^b: Large-footed Myotis (roosting under Queens Parade bridge on 18 January 1993)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

I. Reptiles

Regional. 6^b: 8 species including the Marbled Gecko, White's Skink, Bougainville's Skink, Weasel Skink and Southern Water Skink from a 2-hour search along the Merri Creek upstream of Queens Parade on 28 February 1991

m. Freshwater fish

Regional. 6^a: 2 species on 20 September 1991 (Short-finned Eels and Common Galaxias)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 6^a: 57 species

c. Native mammals

Local. 6^b: 2 species (Large-footed Myotis, Water Rat). **6^a:** 1 species (Common Ringtail Possum)

d. Herpetofauna

Regional. 6^b: 11 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 6^a: 6 species. **6^b:** 2 species

c. Regionally vulnerable fauna (R2 species)

Regional. 6^a: 1 species. **Birds:** Blue-winged Parrot

Regional. 6^b: 1 species. **Mammals:** Large-footed Myotis

d. Regionally rare fauna (R3 species)

Regional. 6^a: 3 species. **Birds:** Little Corella (possible escapee). **Reptiles:** Marbled Gecko. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 6^a: 2 species. **Birds:** Peregrine Falcon, White-winged Triller

Local. 6^b: 1 species. **Reptiles:** White's Skink

f. Regionally restricted fauna (R5 species)

Local. 6^a: 6 species. **Birds:** Nankeen Night Heron, Cattle Egret, Australian Hobby, Rainbow Lorikeet, Long-billed Corella. **Reptiles:** Common Long-necked Tortoise

Local. 6^a: 2 species. **Mammals:** Water Rat. **Reptiles:** Bougainville's Skink

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

Local. 6^a: 5 Nankeen Night Herons roosting along the Merri Creek at the end of Barkly Street North Fitzroy in September 1988

j. Electrofishing or netting rate

Local. 6^a: 27 Short-finned Eels and 1 Common Galaxias electrofished from the footbridge at the end of Roseneath Street Clifton Hill on 20 September 1991

Outlook

The avifauna significance will increase as habitat links improve under the lower Merri Creek revegetation program. The herpetofauna significance is likely to decline due to habitat degradation and disturbance. The polluted nature of the creek appears unable to sustain resident populations of freshwater fish with the exception of the Short-finned Eel.

6^a: Electrofishing Survey: Merri Creek–Roseneath Street Clifton Hill

Map reference. 7922 241150. **Altitude.** 15 m. **Survey date.** 20 September 1991

Vegetation. Instream: submerged and emergent herbfield (poor condition). Bank: Woolly Tea-tree riparian scrub (18.1; poor condition and invaded by White Crack Willow etc.). Frontage: Lightwood–Tree Violet cliff/escarpment shrubland (20.5; poor condition and weed invaded)

Physical Features:

Pools

Substrate. Deep silt and basalt boulders on basalt base

Maximum size (mid-summer). 4 m wide by 2.5 m deep by 100 m long

Riffles

Substrate. Basalt boulders and cobbles on basalt base

Flow (summer urban): Size. 3.0 m wide by 50 m deep. **Velocity.** 0.2 m/sec. **Rate.** 68 ML/day.

About 60% provided by urban runoff

Water quality

Readings not available

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (27); migratory sub-adults. Common Galaxias (1); passage migrant

Alien species numbers/status. Goldfish (2); likely breeding resident. Roach (11); likely breeding resident.

MANAGEMENT

Threatening Processes

Polluted water enters the stream as stormwater runoff and discharge from residential areas and industrial development. The water is turbid and odorous. River Red Gums and Drooping Sheokes are in decline and severe weed invasion has occurred.

Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. There is a riparian and partial escarpment habitat link downstream to the Yarra Bend Park site and a degraded upstream riparian link. The upstream escarpment link has been severed by urban development and roads or eliminated through clearing, modification and weed invasion.

Regional Hydrological Strategy

The lower reaches of the Merri Creek upstream of St Georges Road have undergone extensive frontage revegetation and rehabilitation works. These should continue with a focus on improving instream habitat quality. Upstream of Queens Parade there are fair quality escarpment sections which are being degraded through lack of conservation management. These are in need of similar rehabilitation works to those occurring upstream. With the installation of the fish-way at Dights Falls, Common Galaxias have begun to enter the stream in larger numbers. The middle reach sections where Roach do not occur (Craigieburn to Donnybrook) contain the most suitable water and habitat for galaxias in the stream.

Site 7 McBryde Street–Central Creek–Edwardes Lake Park

Map Reference:	7822 214233 to 7822 207257 (Merri Creek); 7822 211251 to 7822 210263 (Central Creek); 7822 231239 (Edwardes Lake Park). One minute lat/long grids include 37° 42' x 144° 58' to 144° 59' and 37° 43' x 144° 58' to 144° 59'.
Location/Size:	Edgars Creek from Edwardes Lake Park to Broadhurst Avenue Reservoir, Merri Creek from the south to north end of McBryde Street and the Central Creek downstream of Mahoneys Road. Approximately 120 ha.
Municipality:	Cities of Preston and Broadmeadows (west of the Merri Creek).
Land Tenure/Use:	Public: open space and recreation reserves associated with the streams such as Edwardes Lake Park and B.T. O'Connor Reserve; City of Darebin. Proposed freeway: Vic Roads. Edwardes Lake is an important open space and recreation area. The surrounding areas are urban residential, commercial and light industrial areas.
Landforms:	Volcanic and alluvial plains (see MLVP A). Elevation is 60–90 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Woolly Tea-tree riparian scrub (18.2; Merri Creek); Kangaroo Grass plains grassland (23.2; Central Creek); Common Reed–Cumbungi seasonal wetland (25.7; Edwardes Lake); Blunt Pondweed permanent wetland (26.1; Edwardes Lake)

Remnant, degraded or establishing stands: River Red Gum (alluvial plain) grassy woodland (14.3; Edwardes Lake Park); River Red Gum (plains) drainage line woodland (30.1; Edgars Creek); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; Merri Creek); Kangaroo Grass stony knoll grassland (22.1; Central Creek)

Rare species: Rye Beetle-grass (Central Creek)

FAUNAL SIGNIFICANCE: Site 7 McBryde Street–Central Creek–Edwardes Lake Park

Assessment: Regional—Category 3 (C, D, E)

Reference grids for the significance keys include:

7^a: 37° 42' x 144° 58'; Central Creek/Merri Creek

7^b: 37° 42' x 144° 59'; Edwardes Lake Park

7^c: 37° 43' x 144° 58'; lower Edgars Creek

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 7^b: 20 species including 8 species of waterfowl at Edwardes Lake on 3 March 1992

k. Frogs

Local. 7^a: 4 species including the Growling Grass Frog at Merri Creek upstream of B.T. O'Connor Reserve on 3 March 1992

l. Reptiles

Regional. 7^a: 7 species including the Large Striped Skink, Cunningham's Skink, Tussock Skink and Little Whip Snake in a 1 hour herpetofauna search along the Merri Creek upstream of B.T. O'Connor Reserve on 3 March 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Local. 7^b: 44 species at Edwardes Lake Park

d. Herpetofauna

Regional. 7^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 7^b: 6 species. **7^a:** 5 species. **7^c:** 1 species

c. Regionally vulnerable fauna (R2 species)

Regional. 7^a: 1 species. **Birds:** Spotless Crake

Regional. 7^c: 1 species. **Fish:** Tupong

d. Regionally rare fauna (R3 species)

Regional. 7^b: 1 species. **Birds:** Hardhead

e. Regionally depleted fauna (R4 species)

Local. 7^b: 1 species. **Birds:** White-winged Triller

f. Regionally restricted fauna (R5 species)

Local. 7^b: 4 species. **Birds:** Australian Pelican, Great Egret, Nankeen Night Heron, Australian Hobby

Local. 7^a: 4 species. **Reptiles:** Large Striped Skink, Cunningham's Skink, Tussock Skink, Little Whip Snake

F. POPULATION DENSITY: Viability and Abundance—point census

c. Waterfowl

Local. 7^b: 58 birds on 21 April 1988 and 42 birds on 3 March 1992 at Edwardes Lake

g. Rare/restricted colonial fauna

Local. 7^b: small non-breeding colony of Nankeen Night Herons at Edwardes Lake

Outlook

The faunal significance would improve with habitat rehabilitation and enhancement works and restoration of habitat links along the Merri Creek. While many sections along the creek are degraded or used for recreation, some stands of cliff/escarpment shrubland and riparian scrub vegetation are moderately intact. The establishment of a bird sanctuary would attract more waterbirds to Edwardes Lake.

FAUNA

Note. Adjoining areas along Merri Creek at Coburg and Edgars Creek from Merri Creek to Edwardes Lake Park within MUVPA are not included in the site (with the exception of the Tupong locality in the Edgars Creek at Arthur Street, Coburg North).

Other Significant Fauna

Birds

Ec 7^a: Spotless Crake. One amongst reed-beds in Woolly Tea-tree riparian scrub (18.2) along the Merri Creek at B.T. O'Connor Reserve on 3 March 1992. The reedy pools provide suitable habitat and the species appears relatively widespread in the Merri Creek gorge (see also Barry Road and Craigieburn Grassland sites).

Ed 7^b: Hardhead and other waterbirds of Edwardes Lake. Twenty species including eight species of waterfowl were present on 3 March 1992. This included a Hardhead and two Chestnut Teal. Hardheads were rarely recorded during the survey in the urban area. They were observed elsewhere in the district only at the BMG Quarry at Mill Park and Tanunda and Morang Wetlands in Plenty Gorge Park. Seasonal movements of Hardheads into NEM occurred in 1992. The Blunt Pondweed submerged herbfield (26.1) at Edwardes Lake attract the

waterfowl. Three species of cormorants including 10 Little Black, 6 Little Pied and 1 Great Cormorant were present in March 1992. The former two were both seen catching fish from the lake. Dusky Moorhen breed in the Common Reed–Cumbungi emergent herbfield (25.7) on the western side near the islands. An Australian Pelican, Great Egret and Black Swan were present in March 1992.

Ee **7^b: White-winged Triller and other River Red Gum birds at Edwardes Lake Park.** Most of the River Red Gums (alluvial plain grassy woodland; 14.3) on the east side of the lake are lacking nest-hollows. The largest trees support breeding Red-rumped Parrots and Laughing Kookaburras. A White-winged Triller was seen on 3 March 1992, possibly in passage.

Ef **7^b: Nankeen Night Heron.** Two were present at Edwardes Lake on an island and one was flushed from the reeds (26.1) on 21 April 1988. On 3 March 1992, one was roosting during the day on an island and later that evening, was seen taking a Goldfish amongst the reeds. Heron populations may increase under management (see conservation measures).

7^b: Marshland passerines in the reed-beds of Edwardes Lake. The Common Reed–Cumbungi emergent herbfield (26.1) supports Clamorous Reed-Warblers, Golden-headed Cisticolas and probably Little Grassbirds.

Reptiles

Ef **7^a: Herpetofauna of the rocky escarpments and grasslands of Central Creek/Merri Creek.** This area is a proposed freeway reservation. Eleven species were recorded amongst Lightwood–Tree Violet cliff/escarpment shrubland (20.5) above Merri Creek and Kangaroo Grass plains grassland (23.2) between Merri Creek and Central Creek on 3 March 1992. Small outcrops of Kangaroo Grass stony knoll grassland (22.1) occur above Central Creek. Seven species of reptiles were recorded including the Little Whip Snake, Cunningham's Skink and Large Striped Skink at the proposed freeway crossing of Merri Creek on 3 March 1992. One Little Whip Snake was located on the escarpment of Merri Creek and one was located on a stony crest between the Merri and Central creeks. The Tussock Skink was rather common in the stony escarpments of Merri Creek. Fourteen Eastern Three-lined Skinks were recorded in a burnt area at the B.T. O'Connor Reserve on 21 April 1988.

Freshwater fish

Ec **7^c: Tupong in the lower Edgars Creek.** An individual 18 cm long was taken during the Project Platypus study near the end of Arthur Street at Coburg North on 27 February 1995 (Melody Serena pers. comm.). Construction of the fish-way at Dights Falls has facilitated the movement of this species into catchment streams.

7^b: Fish in Edwardes Lake. There are Short-finned Eels in the lake. How they complete their migration to and from the sea is unknown. To return they must somehow negotiate the outlet system of the lake or cross over Edwardes Street from Edgars Creek. The lake was stocked with Rainbow Trout, Redfin and Golden Perch in the 1920s and 1930s and became popular with anglers. These species were fished out or did not breed and have died out. The Mosquito Fish, Goldfish and Loach in the lake probably originate from local aquaria. There are reports of European Carp.

MANAGEMENT

Threatening Processes

See also the Merri Creek Campbellfield and the Darebin Creek Darebin to Bundoora units.

Proposed freeway land. Biological values aside, the shortage of open space, especially areas containing natural vegetation, is an important consideration. A freeway in the narrow section opposite McBryde Street will take up most of the open space. There are already large arterial roads within 2 km to the west, east, north and south. This is an important area for grassland ground fauna, even more so in the context of the surrounding inner northern municipalities. The apparent attitude by planners that the Merri Creek is a conduit for urban wastewater, freeways and high voltage transmission lines needs to change. Community action will be needed if this open space is to be preserved.

Weeds. The escarpments of the Merri Creek are infested with Gorse, Fennel, Montpellier Broom and Chilean Needle-grass.

Rock removal. Much of the surface rock has been removed from the Central Creek grasslands. Most of the area is mown. This has been detrimental to reptile and grassland herb species.

Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. Degraded and fragmented habitat links along the Merri Creek. No effective links at Edwardes Lake Park.

Protect indigenous vegetation and restore habitat links along the Merri Creek. The Merri Creek opposite McBryde Street and the grassland between Merri Creek and Central Creek on the proposed freeway easement support the most intact vegetation remaining in the City of Darebin. The rocky grassland areas support a diverse reptile assemblage. There are significant species and habitats present which need to be protected. Riparian links both upstream and downstream need to be enhanced. Extensive weed control and replanting of indigenous vegetation is required along the Merri Creek. A broader link of River Red Gums and strategic plantings of shrubs (both escarpment and riparian species) would recruit additional riparian and woodland birds. Enhancement of these links will promote the long-term viability of faunal populations, which are currently threatened.

Other Issues—Edwardes Lake Park

Conservation and the local community—education and participation. Given the high public profile and usage of the lake and need for local conservation awareness, interpretation facilities would be a valuable education tool. Community involvement has heralded several lasting achievements around Melbourne (e.g. Organ Pipes, Yarra Bend and Darebin Parklands). This has overcome seemingly insurmountable obstacles such as vandalism and weeds through the development of a sense of caring and understanding.

Revegetation and restoration of the plains flora. Grassland restoration work by Darebin Council should proceed along the east (Silurian sandstone) side of the lake. Fenced enclosures from the public will be needed. Small indigenous shrub plantations containing Black Wattle, Wedge-leaf Hop-bush, Tree Violet, Prickly Moses and Sweet Bursaria have been established. Additional species should include the Lightwood, Blackwood, Drooping Sheoke, Golden Wattle, Gold-dust Wattle, Common Everlasting, Grey Everlasting and Rock Correa. Yellow Gum and Yellow Box and herbs such as Spiny-headed Mat-rush, Black-anther Flax-lily and Kangaroo Grass should also be planted.

Consideration should be given to bulk transplantation of grassland/substrate from local areas (e.g. freeway land along the Merri or Central Creeks) should they be developed. Plants/substrates from the alluvial plains should be established on the eastern side of the lake while those from the volcanic plains should be established on the western side.

Nest boxes for the Striated Pardalote and bats should be located in the River Red Gums (see sites 27 and 28). As the existing River Red Gums mature and produce tree hollows additional species such as the Sacred Kingfisher will likely nest in the area. Additional plantings of River Red Gums and tall wattles may attract beneficial canopy insectivores such as the Spotted Pardalote.

Wetland habitat development. Major issues that should be addressed are the formulation of a wetland restoration plan and a reduction of pest species populations including the Mallards and domestic geese. The wetland plan should address the establishment of a diverse and functional wetland system and its role in the regional wetlands complex. The introduction of native fish species such as the Southern Pigmy Perch into the lake should be investigated. The alien Great Reedmace should be replaced by the native Cumbungi (*Typha orientalis*) and other emergent aquatics including the Tall Spike-sedge and River Club-sedge. This would attract cover-dependent waders such as the Australian Spotted Crake and enable more substantial populations of frogs to establish (e.g. Growling Grass Frog).

Establish a bird sanctuary on a section of the lake. A sanctuary encompassing one or more of the islands is essential if species such as the Nankeen Night Heron are to breed. This area would need to be restricted from human disturbance. The islands should be replanted with River Red Gums and dense-foliaged indigenous species such as Silver Wattle and Blackwood to provide suitable bird roosts. Screening plantations of these species should be established at key points around the lake. Some shallows free from swimming/boating activity and the establishment of floating aquatic plants such as the Water-ribbons and Floating Pondweed may enable the Australasian Grebe and Eurasian Coot to breed.

MLVP B MERRI CREEK CAMPBELLFIELD

This management unit consists of one site of state faunal significance (site 9) and one of regional faunal significance (site 8).

Map Reference: 7822 201263 to 7822 212313 (Merri Creek).

Location/Size: Merri Creek and escarpments and surrounding open space from Mahoneys Road to Cooper Street, Campbellfield. Approximately 330 ha.

Municipality: Cities of Whittlesea and Hume.

Description: The unit contains a small section of the Merri Creek and adjacent lava plains. The Craigieburn Grassland joins to the north of Cooper Street. To the south of Cooper Street the plains abutting the creek have become constricted by development or been degraded by extensive quarrying. To the west lies residential, industrial and commercial development, to the east open space and a large quarry and to the south it joins the residential area toward Mahoneys Road. The Cooper Street site lies on the opposite bank of the creek to the quarry. The plains surrounding the creek become constricted to the south of Barry Road on entering the residential area. The unit contains the nearest areas to Melbourne along the Merri Creek of relatively extensive native grassland and intact riparian vegetation.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands. The unit contains the downstream section of a gorge formed by the mid-reaches of the Merri Creek. The creek has cut the deepest section of the Merri Creek gorge, creating an exposure of the Silurian sandstone bedrock.

Landforms

Volcanic plain: stony crests, buckshot crests, stony plains, gilgai plains, swales (few) and creek valley/gorge with escarpments, cliffs and terraces (Merri Creek) and several rocky, ephemeral drainage lines. Alluvial plain: sand-plain (west of the Merri Creek at Mahoneys Road) and sedimentary cliffs and reef (Barry Road gorge of the Merri Creek). The Merri Creek gorge contains columnar basalt cliffs, boulder screes and rocky escarpments, fast-flowing riffles of basalt cobbles and tessellated basalt pavement and slow-flowing open water or reedy pools flanked by alluvial terraces. Elevation is 90–160 m.

Hydrology

The Merri Creek is perennial and contains deep, reed-lined pools and shallow riffles. It loses elevation relatively rapidly through the unit as it descends from elevated inland plains onto low-lying coastal plains. The water is relatively fast-flowing. Some of the pools exceed 2 m in depth. Small swales at the head of ephemeral drainage lines drain the larger stony crests. Aquifers may connect the watertable under the creek to the quarries.

Rainfall: 600–620 mm.

Site 8 Barry Road Gorge

- Map Reference:** 7822 211273 to 7822 212287 (Merri Creek). One minute lat/long grids include 37° 40' x 144° 58'.
- Location/Size:** Merri Creek and surrounding open space from 1 km north of Mahoneys Road to Barry Road. Approximately 130 ha.
- Municipality:** Cities of Whittlesea and Hume.
- Land Tenure/Use:** Public: small areas of road reservation (Vic Roads) and stream and floodway zone (Melbourne Water). Private: zoned mixed industrial and general farming. Formerly farmland now in the path of urban development. Residential development to the south and west and extractive industry to the north.
- Landforms:** Volcanic and alluvial plains (see MLVP B). Elevation is 90–120 m.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Relatively intact and extensive stands: Woolly Tea-tree riparian scrub (18.2); Kangaroo Grass plains grassland (23.2)

Partially intact or small stands: Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Brown-back Wallaby-grass seasonal wetland (25.3)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); Grey Box grassy woodland (14.8; Scots Church Campbellfield); Golden Wattle–Wedge-leaf Hop-bush cliff/escarpment shrubland (20.4)

Vulnerable species: Matted Flax-lily

Notable features: the downstream end of the Merri Creek gorge at Barry Road is intact and supports the regionally endangered Silky Blue-grass and Chamomile Sunray. There are disjunct occurrences of Wedge-leaf Hop-bush on sedimentary cliffs and Muttonwood in sedimentary rapids at Barry Road gorge. A few Matted Flax-lilies occur in Brown-back Wallaby-grass seasonal wetland around gilgais east of the creek at Barry Road.

FAUNAL SIGNIFICANCE: Site 8 Barry Road Gorge

Assessment: Regional—Category 2 (C, D, E)

Reference grids for the significance keys include:

8^a: 37° 40' x 144° 58'; Merri Creek at Barry Road gorge

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 8^a: 8 species including the Australasian Grebe, Nankeen Night Heron and Great Cormorant on 12 March 1991

k. Frogs

Regional. 8^a: 6 species including the Common Spadefoot Toad on 12 March 1991

l. Reptiles

Regional. 8^a: 10 species including the Marbled Gecko and Lowland Copperhead from a 5-hour search on 12 March 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 8^a: 50 species

c. Native mammals

Local. 8^a: 2 species: Fat-tailed Dunnart and Water Rat

d. Herpetofauna

Regional. 8^a: 22 species

e. Freshwater fish

Local. 8^a: 1 species: Short-finned Eel

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 8^a: 8 species

c. Regionally vulnerable fauna (R2 species)

Regional. 8^a: 3 species. **Birds:** Spotless Crane, Spotted Harrier. **Mammals:** Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 8^a: 2 species. **Reptiles:** Murray River Tortoise, Marbled Gecko

e. Regionally depleted fauna (R4 species)

Regional. 8^a: 3 species. **Birds:** Swamp Harrier, Striated Fieldwren. **Reptiles:** Red-bellied Black Snake

f. Regionally restricted fauna (R5 species)

Regional. 8^a: 11 species. **Birds:** Nankeen Night Heron, Little Eagle, Brown Songlark, Singing Bushlark. **Mammals:** Water Rat. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

f. Frogs

Local. 8^a: About 10 Growling Grass Frogs chorusing in a large pool downstream of Barry Road on 2 December 1986

Outlook

The Striped Legless Lizard aside, this site should be considered of comparable faunal significance to the Cooper Street site to the north. Search and discovery of Striped Legless Lizards would raise the faunal significance to State. A diverse assemblage of 16 reptile species was recorded. The site is important for reptiles but contact with the urban area has largely restricted them to the creek valley. Continued degradation of the creek and elimination of native grassland and open space to either side will cause a further decline in herpetofauna and general faunal significance unless intensive management is undertaken. Without this, the site may be reduced to the significance (local) of the next 8 km downstream.

FAUNA

Other Significant Fauna

Birds

Ec **8^a: Spotless Crane.** One in Common Reeds amongst Woolly Tea-tree riparian scrub (18.2) lining a large pool downstream of Barry Road on 19 January 1993 (Martin Schulz pers. comm.).

Ec **8^a: Spotted Harrier.** Observed along with the Swamp Harrier over the gorge on 19 January 1993 (Martin Schulz pers. comm.) Five bird of prey species were recorded. Other significant members include the Little Eagle, which was seen over the open space to the east of the creek on 13 March 1991.

Ee **8^a: Striated Fieldwren.** Several amongst Lightwood–Tree Violet cliff/escarpment shrubland at Barry Road gorge on 12 March 1991.

Ef **8^a: Nankeen Night Heron.** One roosting amongst Woolly Tea-tree riparian scrub (18.2; in a Silver Wattle) fringing a deep pool just north of Barry Road on 12 March 1991.

Ef **8^a: Brown Songlark, Singing Bushlark and other grassland birds.** These two species and the Stubble Quail are relatively common in the Kangaroo Grass plains grassland (23.1). They are rare to absent from urban sections of the creek nearer Melbourne due to the lack of grassy plains frontages.

Mammals

Ed **8^a: Fat-tailed Dunnart.** One located east of the creek under a flat rock amongst Kangaroo Grass stony knoll grassland (22.1) on 12 March 1991. The Lowland Copperhead, Little Whip Snake, Large Striped Skink, Eastern Three-lined Skink and Tussock Skink were also present on the stony crests.

Ef **8^a: Water Rat.** Several were active in the pools and riffles north of Barry Road (18.2) at sundown on 12 March 1991. Feeding sites with freshwater mussels and crayfish carapaces were present amongst the tessellated pavements.

Reptiles

Ed **8^a: Murray River Tortoise.** One was observed in the pool upstream of Barry Road on 19 January 1993 (Martin Schulz pers. comm.). The tortoise has been introduced into the Yarra system.

Ed **8^a: Marbled Gecko.** One located amongst crevices in the basalt cliffs (20.5) upstream of Barry Road on 12 March 1991. They were observed in only three of the sites further upstream on the Merri Creek.

Ee **8^a: Red-bellied Black Snake.** The black snake inhabits areas where frogs and skinks are abundant along the creek such as the dense sedge and shrubland lining deep pools (18.2) and boulder screes at the foot of basalt cliffs (20.5). One was observed downstream of Barry Road on 2 December 1986. On frequency of sightings, the species appears more common along the Merri Creek than elsewhere in NEM.

Ef **8^a: Grassland reptiles at Barry Road.** The site supports a diverse herpetofauna and constitutes one of the nearest occurrences to Melbourne for several species (e.g. Lowland Copperhead). The Large Striped Skink, Bougainville's Skink, Eastern Three-lined Skink, Tussock Skink and Little Whip Snake were located east of the creek amongst Kangaroo Grass stony knoll grassland (22.1) on 12 March 1991. Several Southern Water Skinks and a Lowland Copperhead were present amongst boulder screes at the base of the high cliffs while two Cunningham's Skinks were seen higher in the cliffs (20.5) on the eastern side of the pool upstream of Barry Road in March 1991. The reptile fauna is more diverse than the Cooper Street site to the north and particularly for snakes, is the most diverse remaining close to Melbourne. It supports substantial populations of most volcanic plains herpetofauna species but these require management and the protection of the habitat link to the Cooper Street site.

Ef **8^a: Common Spadefoot Toad at Barry Road.** Thirty were chorusing in the Brown-back Wallaby-grass seasonal wetland (25.3) of gilgais and stony knoll apron swales and Kangaroo Grass plain grassland (23.1) to the east of the creek on a rainy evening in March 1991.

8^a: Potential habitat for the Striped Legless Lizard. The species may be present and appropriate trapping survey to locate it should be conducted.

Freshwater fish

8^a: Barry Road gorge. While the pools support relatively intact native instream and riparian vegetation the dominant fish are the alien Roach, Redfin and Mosquito Fish. The water is mildly polluted from upstream stormwater and farmland runoff and sewage treatment plant outfall. A Short-finned Eel was seen. The red gum and reed-lined pool north of Barry Road may still support Freshwater Blackfish. A fish survey is needed.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. An intact upstream habitat link to the Cooper Street site.

Encroaching development. Ground fauna populations are diminishing due to fragmentation of habitat links. Connectivity to other sites has been substantially restricted by residential development. The quarry area and open space to the east of the creek is important for these species.

Lack of adequate buffer areas.

Strengthen habitat links. The site provides the closest to Melbourne intact and substantial area of native grassland habitat along the Merri Creek. The riparian and instream habitat is of high quality but falls away rapidly immediately downstream of the site. It has considerable biological significance in the urban context and forms a habitat link to significant areas along the creek to the north.

Incorporation into the Merri Creek

Conservation Area. On the basis of the biological values of the site, the creek and the open space to the east presently owned by Melbourne Water and used as a retarding basin should be incorporated into a 'green web' park under the Open Space 2000 initiative. This would provide an extension to the grassland conservation reserve proposed for further north in the Merri Creek Conservation Area. If this cannot be achieved, until such time as development proceeds (if at all), the site needs constant protection and management (e.g. weed control and prevention of further rock removal and vehicle incursions through adequate fencing) to maintain faunal values. Unused grassland within adjacent developments should be placed under conservation management.

Acquisition/conservation management of adjacent land. Habitat protection and indigenous species plantings should be promoted in adjacent residential areas and proposed estates.

Land protection—weed/predator control. The link should be reinforced through on-site land protection activities (e.g. weed control).

Regional Hydrological Strategy

Proximity of upstream quarries to creek, alteration to groundwater flows and dust generation. Upstream quarries near Cooper Street are located close to the creek. They have had an observed impact on their surrounding terrestrial environment through dust generation, soil and noise disturbance and the spread of weeds and vermin. Their effect on the stream and groundwater flows is unknown. Some have been infilled by tips. It is likely that leachate from the tips enters the stream or groundwater.

Declining water quality of creek.

Monitor/improve water quality of creek.

Other Issues

High incidence of uncontrolled summer grassfires.

Less frequent early to mid-summer burning.

Disturbance, rubbish dumping and weed and vermin invasion.

Public interpretation. Being close to urban areas and relatively accessible it offers the opportunity for public interpretation of grassland conservation and flora and fauna. It also has scope for involvement by community groups for land protection work. There are also significant scenic, geological and landform features along the creek.

Disbanding the proposed freeway traversing the site. The open space made available should be managed for conservation purposes.

Implementation of Native Vegetation Clearance Controls on private land.

Site 9 Cooper Street

Map Reference:	7822 212287 to 7822 212313 (Merri Creek). One minute lat/long grids include 37° 39' x 144° 57' to 144° 58'.
Location/Size:	Merri Creek and surrounding open space from Barry Road to Cooper Street. Approximately 200 ha.
Municipality:	Cities of Whittlesea and Hume.
Land Tenure/Use:	Public: small areas of road reservation owned by Vic Roads and stream and floodway zone owned by Melbourne Water. Private: zoned industrial. Formerly farmland which now lies in the path of urban development. Industrial/commercial and residential development occurs to the south and west and extractive industry occurs to the east.
Landforms:	Volcanic plain (see MLVP B). Elevation is 100–150 m.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: Woolly Tea-tree riparian scrub (18.2); Kangaroo Grass plains grassland (23.2)

Relatively intact and extensive stands: Brown-back Wallaby-grass seasonal wetland (25.3)

Partially intact or small stands: River Red Gum grassy woodland (14.1); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1)

Endangered species: Swollen Swamp Wallaby-grass

Rare species: *Agrostis aemula* var. *setifolia*

Critical assemblages or populations: Reference stands of Woolly Tea-tree riparian scrub (along with those at Craiggieburn Grassland, the most intact in NEM) and Kangaroo Grass plains grassland (one of few ungrazed, species-rich stands in NEM).

FAUNAL SIGNIFICANCE: Site 9 Cooper Street

Assessment: State—Category 3 (B); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

9^a: 37° 39' x 144° 58'; Merri Creek/Cooper Street Grassland, Campbellfield

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 9^a: Striped Legless Lizard (15 August 1989)

Regional. 9^a: Swift Parrot (one sighting on 15 August 1989; this species is considered vagrant to the area)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Local. 9^a: 5 species on 20 November 1989

l. Reptiles

Regional. 9^a: 10 species between 17 and 31 January 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 9^a: over 70 species

d. Herpetofauna

Regional. 9^a: 19 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 9^a: 7 species

b. Regionally endangered fauna (R1 species)

Regional. 9^a: 1 species. **Reptiles:** Striped Legless Lizard

c. Regionally vulnerable fauna (R2 species)

Regional. 9^a: 1 species. **Birds:** Spotted Harrier

e. Regionally depleted fauna (R4 species)

Regional. 9^a: 5 species. **Birds:** Whistling Kite, Swift Parrot, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 9^a: 12 species. **Birds:** Banded Lapwing, Australian Hobby, Purple-crowned Lorikeet, Long-billed Corella, Brown Songlark, Singing Bushlark. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, Tussock Skink, Little Whip Snake

g. Nesting birds of prey/parrots

Local. 9^a: Black-shouldered Kite (not one of the designated species); nesting in a copse of Black Wattles at the rear of the factories on Northbourne Road on 13 February 1993

F. POPULATION DENSITY: Viability and Abundance—point census

o. Regionally restricted fauna (R5 species)

Regional. 9^a: Banded Lapwing (10 in paddocks in the southern section of Cooper Street Grassland on 19 March 1991); Tussock Skink (15 in a recently burnt rocky grassland on 31 January 1990)

Outlook

Similar to the Barry Road Gorge site, maintenance of faunal significance depends on management investment. Further fragmentation of the grasslands for factory or residential areas and severance of links to Craigieburn Grassland will eliminate reptile species. Loss of the Striped Legless Lizard could result in a decline to low regional significance.

FAUNA

Rare or Threatened Fauna

Bb 9^a: Swift Parrot. Two transient birds in River Red Gum grassy woodland (14.1) on 15 August 1989 (Damien Cook pers. comm.). They were presumably feeding on flower buds and leaf psyllids (see Gresswell Forest; site 25).

Bb 9^a: Striped Legless Lizard. One located in Kangaroo Grass plains grassland (23.2) under a piece of timber about 100 m west of the creek on 15 August 1989 (Damien Cook pers. comm.). Cooper Street constitutes one of the nearest remaining occurrences to inner Melbourne of this species.

Other Significant Fauna

Birds

Ec 9^a: Spotted Harrier. One over the northern section of Cooper Street Grassland on 19 March 1991. Most observations in NEM were from late summer to winter. A minor irruption from the inland occurred in 1991.

Ee 9^a: Rufous Songlark and other River Red Gum woodland birds. River Red Gum grassy woodland (14.1) at Cooper Street supports small populations of woodland and shrubland birds which are absent from grasslands in the site. These include the Black-shouldered Kite, Swift Parrot, Musk Lorikeet, Purple-crowned Lorikeet, Long-billed Corella, Eastern Rosella, Tawny Frogmouth, Australian Owllet-nightjar, Tree Martin, Grey Shrike-thrush, Black-faced Cuckoo-shrike, Rufous Songlark, Dusky Woodswallow, Mistletoebird, Striated

Pardalote, Grey Butcherbird and Australian Raven. There are few records of Australian Owlet-nightjars from red gum woodlands in GM.

Ef 9^a: Banded Lapwing, Brown Songlark and Singing Bushlark. Each recorded on 19 March 1991. Ten lapwings were in open grazing land in the southern section of Cooper Street Grassland. This species is less common on the volcanic plains of NEM than on the Werribee Plains. It visits in autumn–winter. The songlark and bushlark were recorded in dense Kangaroo Grass plains grassland (23.2).

Reptiles

Cl 9^a: Reptile surveys from September 1988 to January 1990. Twelve species were recorded. Details of area searches were kindly provided in an unpublished report by Damien Cook. Visits comprised two half days (15 August 1989 and 20 November 1989) and a full day (17 January 1990). A fourth half-day visit by Damien Cook, Grant Turner and this author was made on 31 January 1990. The area was also searched by Grant Turner on 18 September 1988. Habitats surveyed are listed under Habitat Significance.

Details of the surveys include:

- Common Long-necked Tortoise: one in creek pool on 18 September 1988 (18.2)
- Striped Legless Lizard (see Rare or Threatened Fauna; *Bb*)
- Large Striped Skink: two located amongst dense grassland on 18 September 1988; uncommon in rocky grassland areas (23.2)
- Cunningham's Skink: adults and juveniles basking on ledges of columnar basalt cliffs on the upper escarpment (20.5)
- Common Blue-tongued Lizard: observed moving through long grass and entering a stacked pile of basalt (23.2)
- Tussock Skink: many individuals ranging in size from hatchlings to adults located under loose rocks in a recently burnt area near the Black Wattles on 17 January 1990; although the Kangaroo Grass had only just begun to regenerate, individuals were located in cavities under most pieces of basalt; 15 were located in this area on 31 January 1990 (the burn was in late December; 23.2)
- Eastern Three-lined Skink: as for Tussock Skink but not as common (23.2)
- Southern Water Skink: associated with rocky sections along the creek bank, loose basalt screes on the creek terrace and lower escarpment and occasionally amongst rubbish on the upper escarpment (18.2 and 20.5)
- Little Whip Snake: located under embedded rocks and occasionally rubbish such as car bonnets on the top of the escarpment (20.5)
- Red-bellied Black Snake: freshly sloughed skin located in the burnt area about 300 m west of the creek escarpment on 31 January 1990 (23.2)
- Eastern Brown Snake: complete shed skin amongst large slabs of basalt in the burnt area on 17 January 1990 (23.2)
- Lowland Copperhead: one sunning on a rock in dense Kangaroo Grass about 200 m west of the creek escarpment on 31 January 1990 (23.2).

Frogs

Ck 9^a: Frog surveys from August 1989 to January 1990. Five species were recorded (searches/habitats as for *Cl*). Details of the surveys include:

- Common Froglet: moist cavities under rocks, wood and car debris (23.2)
- Southern Bullfrog: calling from deeper pools along the creek (18.2)
- Spotted Marsh Frog: calling from reed-beds along the creek (18.2) and located in moist soil in a cavity under an embedded surface rock (23.2)
- Growling Grass Frog: calling from reed-beds along the creek (18.2)
- Southern Brown Tree Frog: calling from reed-beds along the creek (18.2).

Ee 9^a: Bibron's Toadlet. One calling from Common Tussock-grass plains grassland (23.1) near Cooper Street on 9 June 1988.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. An intact riparian habitat link upstream to the Craigieburn Grassland site. Upstream grassland links have been partially eliminated (e.g. by Cooper Street and commercial development to the west of the creek). An intact link downstream to the Barry Road Gorge site.</p>	
<p>Urban development—loss of habitat links and inadequate buffer areas. Adjacent development has already restricted the controlled summer burning option required for effective grassland management. Further development will render this management increasingly more difficult. Development has restricted faunal movement to grassland habitats elsewhere.</p>	<p>Strengthen habitat links. The site provides an important habitat link between Craigieburn Grassland and urban sections of the Merri Creek and has high floral and faunal values. Connectivity to other sites has been substantially restricted by industrial and commercial development and roadways. However, diverse populations of grassland herpetofauna species are still present. All such areas of faunal significance should be protected in accordance with the Regional Habitat Link Strategy. The habitat link should be reinforced through on-site land protection activities (e.g. weed control).</p> <p>Merri Creek Conservation Area/Green Web Park (see Craigieburn Grassland site). The formation of a nature conservation reserve along the Merri Creek from Barry Road Gorge to Craigieburn Road East is the first recommendation of the Regional Habitat Link Strategy for North East Melbourne. A section of the Cooper Street Grassland adjoining the proposed freeway reserve has been incorporated into a grassland reserve. This is being managed by Melbourne Parks & Waterways.</p> <p>This links Melbourne Water land at Barry Road. Incorporating additional areas of the grassland into a reserve (in lieu of the freeway going ahead) rather than allowing subdivision is viewed as critical. Until such time, the site needs constant protection and management (e.g. weed control and adequate fencing to prevent further rock removal and vehicle incursions) to maintain faunal values.</p> <p>Acquisition/conservation management of adjacent land. Unused grassland within adjacent developments should be placed under conservation management. Promotion of habitat protection and indigenous species plantings in adjacent industrial estates is desirable. Should quarry land to the east of the creek become available, it should be acquired into the park and managed for conservation purposes.</p>
Regional Hydrological Strategy	

Declining water quality of the Merri Creek.

The water quality is substantially lower than upstream sections, probably because of urban runoff and sewage treatment plant outflow from Craigieburn and leachate from the Cooper Street tips.

Monitor/improve water quality of creek.

Other Issues

High incidence of uncontrolled summer grassfires.

These are becoming more frequent. Repeated burning of sections has killed many of the wattles and follow-up regeneration.

The fire at Cooper Street killed many of the mature Black Wattles. While wattles require periodic burning for seed germination, fires at short intervals kill regenerating seedlings and deplete the soil seed store. Frequent fires, as is happening downstream in the Barry Road Gorge site could eliminate the wattles.

Disturbance and weed and vermin invasion.

Proximity to industrial, commercial and residential areas and ease of access has caused site disturbance and habitat deterioration in recent years. Off-road vehicles and trail bikes have been able to enter the site from beside the factories on Northbourne Road and rubbish dumping (e.g. stripped cars) has taken place. Weed infestations are present, particularly advancing bands of Chilean Needle-grass, Toowoomba Canary-grass, Ox-tongue and Paspalum in freshwater meadows adjoining Cooper Street and Sweet Briar and Gorse on the creek escarpment. Rocks have been removed from areas near the factories. Several feral cats have been seen.

Periodic early to mid-summer burning. A patch of grassy shrubland (Black Wattle) in the west of the site was burnt in December 1989. Subsequent searches revealed large surviving populations of juvenile and adult Eastern Three-lined Skinks and Tussock Skinks.

Occasional early to mid-summer burning appears not to harm these cover-dependent skinks provided ample, adjacent unburnt refugia is present. However, these skinks are rare in degraded grassland areas south of Barry Road which are burnt more or less annually at this time.

If summer burning were to be conducted so as to maximise grassland plant species diversity, most species of grassland fauna would tolerate mosaic burning on a 5-year rotation. Striped Legless Lizards appear intolerant to any but the most minimal summer burning regime. Shrubland species require longer intervals between fires to enable seedlings to reach maturity and set seed.

Public interpretation. Being close to urban areas and relatively accessible it offers the opportunity for public interpretation of grassland conservation issues. It also has scope for involvement by community groups for land protection work. It contains an Aboriginal scar tree and significant scenic, geological and landform features along the creek.

Implementation of Native Vegetation Clearance Controls on adjacent private land.

MLVP C MERRI CREEK CRAIGIEBURN TO DONNYBROOK

This management unit consists of one site of national faunal significance (site 10) and two sites of state faunal significance (site 11 and 12) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7822 210313 to 7822 196429 (Merri Creek).

Location/Size: The Merri Creek and adjacent catchment between Cooper Street and Donnybrook Road. Approximately 1300 ha.

Municipality: City of Whittlesea.

Description: The unit contains a native vegetation link of private land containing broad-acre farmland associated with the Merri Creek. To the east of the creek lie treeless plains and grassy woodlands, the latter being the western edge of the large stand of River Red Gums which stretch eastwards across the Plenty Lowland Volcanic Plains to Yan Yean. The Merri Creek or North Eastern Railway generally form the western boundary. South of Craigieburn Road to the west lies industrial, residential and commercial development spread along the Hume Freeway. Broad-acre farmland and quarries lie to the north of Craigieburn Road.

The urban growth period of the 1970s and 1980s eliminated substantial areas of grassland in the inner sections of Thomastown, Broadmeadows and Bundoora. Since the commencement of this study in 1986, areas of native grasslands and their fauna have been eliminated throughout the volcanic plains. Causes include urban development, increased rate of rock removal from paddocks, conversion from broad-acre sheep grazing to small-acre cattle grazing farms and the advance of Chilean Needle-grass.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands. It contains the mid-reaches of the Merri Creek after it descends from the Merri Upland to Lowland Volcanic Plains, forming the upstream section of a long and narrow gorge.

Landforms

Foothill: hill-crest and hill-slopes (Summer Hill). Volcanic plain: stony crests, stony rises, buckshot crests, stony plains, gilgai plains, silt plains, creek valley/gorge with escarpments, cliffs and terraces, ephemeral rocky drainage lines, dry lake, swamps, swales and quarries. The Merri Creek gorge commences just downstream of Donnybrook. It contains columnar basalt cliffs, boulder screes and escarpments, shallow riffles of basalt cobbles and tessellated pavements and deep, open water pools flanked by alluvial terraces. Elevation is 130–220 m.

Hydrology

The Merri Creek becomes perennial downstream of Donnybrook, indicating that it is fed from underground springs. After heavy rains the creek water rises 3–4 m at the top of the gorge.

Rainfall: 600–630 mm.

Site 10 Craigieburn Grassland

Map Reference:	7822 210313 to 7822 192364 (Merri Creek). One minute lat/long grids include 37° 36' x 144° 56' to 144° 57' and 37° 37' x 144° 57'.
Location/Size:	Approximately 480 ha.
Municipality:	Cities of Whittlesea and Hume.
Land Tenure/Use:	Public: road reservation (Vic Roads). Private: presently zoned rural. Broad-acre farm settlement with sheep and cattle grazing.
Landforms:	Foothill and volcanic plain (see MLVP C). Elevation is 130–190 m.

Natural Heritage Values

Landscape. Craigieburn Grassland supports intact volcanic stream and plain landscapes and a diversity of habitats not represented elsewhere in GM (i.e. a unique representation of this ecosystem). Another major landscape value is the extent of these habitats and connectivity of its habitat links (or effectiveness of ecosystem function). This is critical to the viability of faunal populations.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point on the Merri Creek at O'Herns Road ford

Invertebrates. Freshwater crayfish (*Engaeus quadrimanus*) at electrofishing site

HABITAT SIGNIFICANCE:

Assessment: Very High—Category 1

Reference stands: Woolly Tea-tree riparian scrub (18.2; MC); Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Common Spike-sedge drainage line herbfield (24.1; SH); Brown-back Wallaby-grass seasonal wetland (25.3); MC = Merri Creek; SH = Summer Hill drainage line; GS = Grassland/Seasonal Wetland

Relatively intact and extensive stands: Lightwood–Tree Violet cliff/escarpment shrubland (20.5; MC); Kangaroo Grass plains grassland (23.2; often reduced to low cover wallaby-grass grazing land)

Partially intact or small stands: Common Blown Grass (brackish meadow) seasonal wetland (25.8; dry lake in northern GS)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1)

Endangered species: Swollen Swamp Wallaby-grass (GS), Tough Scurf-pea (SH)

Vulnerable species: Curly Sedge (SH), Matted Flax-lily (SH), Swamp Plantain (*Plantago gaudichaudii* ss.; Ecology Australia 1996; SH), Small Milkwort (GS)

Rare species: Plains Flax-lily (*Dianella* sp. aff. *longifolia*; MC), *Agrostis aemula* var. *setifolia* (GS), *Amphibromus* sp. aff. *nervosus* (Ecology Australia 1996; GS), Spurred Spear-grass (GS), Rye Beetle-grass (MC), Slender Tick-trefoil (MC), Dusky Scurf-pea (SH)

Critical assemblages or populations: Volcanic Plains Ecological Reference Area and Strategic Habitat Link. The only site with reference stands of five volcanic plains plant communities (riparian scrub, stony knoll grassland, plains grassland, drainage line herbfield and seasonal wetland) in GM. The site contains 13 VROT plant species which is the highest representation known in GM. Several of these are the most substantial and secure populations known in GM (Curly Sedge, Dusky Scurf-pea, Tough Scurf-pea). It also supports high representativeness of critical flora (over 100 species). The Summer Hill drainage line and Merri Creek support the most extensive stands of significant vegetation and flora species. Smaller areas of significant species and habitats are widespread. Stands of cliff/escarpment shrubland along Merri Creek, while thinned and weed invaded, are some of the most intact on the volcanic plains of GM. The occurrence of Common Blown Grass seasonal wetland at the dry lake in the north is the only one known in GM. It supports several disjunct plant species (e.g. Plains Buttercup, Annual Celery).

FAUNAL SIGNIFICANCE: Site 10 Craigieburn Grassland

Assessment: National—Category 2 (B); State (B, C, D, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

10^a: 37° 36' x 144° 57'; Craigieburn Grassland north (north of E/W stone wall)

10^b: 37° 37' x 144° 57'; Craigieburn Grassland south (O'Herns Road to stone wall)

10^c: 37° 37' x 144° 58'; Craigieburn Grassland east/boundary with Hendon Park

10^d: 37° 38' x 144° 57'; Merri Creek Cooper Street to O'Herns Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

National. 10^c: Southern Lined Earless Dragon

b. Vulnerable fauna

National. 10^a: Plains-wanderer (2 sightings; breeding), Striped Legless Lizard

State. 10^b: Striped Legless Lizard

Unranked. 10^a: Spot-tailed Quoll (Merri Creek at Craigieburn Road East in 1910)

c. Rare fauna

Regional. 10^a: Red-chested Button-quail (breeding), Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 10^a: 4 species including the White-striped Freetail Bat trapped amongst River Red Gums along the Merri Creek downstream of Craigieburn Road East between 30 and 31 January 1990

k. Frogs

Regional. 10^a: 7 species including the Common Spadefoot Toad heard from the Craigieburn Road East bridge on 23 March 1989

l. Reptiles

State. 10^a: 12 species including the Marbled Gecko (basalt cliff), Eastern Three-lined Skink, Southern Water Skink (9), Bougainville's Skink, Little Whip Snake (7) and Striped Legless Lizard (2) in a 4 hour search on the east side of the creek between O'Herns Road and Craigieburn Road East on 15 June 1988

m. Freshwater fish

Regional. 10^b: 2 species electrofished at O'Herns Road on 1 February 1989 (12 Short-finned Eel and 1 Flat-headed Gudgeon)

Regional. 10^a: 3 species taken in cage traps in Merri Creek upstream of Aitken Creek on 4 February 1992 (3 Short-finned Eel, 1 Common Galaxias and 1 Freshwater Blackfish)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 10^a: over 90 species

b. Native birds

Regional. 10^a: over 50 species

c. Native mammals

Regional. 10^a: 10 species

d. Herpetofauna

State. 10^a: 26 species

e. Butterflies

Regional. 10^a: 15 species (the most diverse assemblage known on the volcanic plains of NEM)

f. Freshwater fish

Regional. 10^a: 3 species (see *Cm*)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 10^a: 19 species

b. Regionally endangered fauna (R1 species)

State. 10^a: 4 species. **Birds:** Red-chested Button-quail, Plains-wanderer. **Reptiles:** Striped Legless Lizard.
Butterflies: Chequered Swallowtail (breeding)

Regional. 10^b: 1 species. **Reptiles:** Striped Legless Lizard

Regional. 10^c: 1 species. **Reptiles:** Southern Lined Earless Dragon

c. Regionally vulnerable fauna (R2 species)

Regional. 10^a: 5 species. **Birds:** Spotless Crake, Singing Honeyeater, Zebra Finch. **Mammals:** Fat-tailed
Dunnart. **Fish:** Freshwater Blackfish

Regional. 10^b: 1 species. **Fish:** Flat-headed Gudgeon

d. Regionally rare fauna (R3 species)

Regional. 10^a: 3 species. **Reptiles:** Marbled Gecko. **Frogs:** Plains Froglet. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 10^a: 7 species. **Birds:** Latham's Snipe, Swamp Harrier, Peregrine Falcon, Striated Fieldwren.
Reptiles: Red-bellied Black Snake. **Frogs:** Bibron's Toadlet. **Butterflies:** Small Copper

Local. 10^b: 1 species. **Reptiles:** Red-bellied Black Snake

f. Regionally restricted fauna (R5 species)

Regional. 10^a: 18 species. **Birds:** Banded Lapwing, Barn Owl, Purple-crowned Lorikeet, Little Lorikeet, Brown
Songlark, Spiny-cheeked Honeyeater, Singing Bushlark. **Mammals:** Water Rat. **Reptiles:** Common Long-
necked Tortoise, Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip
Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Phigalia Skipper, Meadow Argus

F. POPULATION DENSITY: Viability and Abundance—point census

l. Regionally vulnerable fauna (R2 species)

Regional. 10^a: over 10 Fat-tailed Dunnarts seen while spotlighting by car in the north-central section on 28
August 1991

o. Regionally restricted fauna (R5 species)

Regional. 10^a: 7 Little Whip Snakes from a 4-hour rock survey on the east side of Merri Creek south of Aitken
Creek on 15 June 1988

Outlook

The site contains the most diverse and significant native grassland fauna and flora assemblage and the highest representation of rare or threatened grassland species (Red-chested Button-quail, Plains-wanderer, Southern Lined Earless Dragon and Striped Legless Lizard) in GM. The national significance is dependent on specific management and protection of the habitat of these species. Each is threatened by loss of native grassland habitat and predation from foxes and probably cats. Fox populations need to be controlled. The high diversity and population density of reptiles is critically dependent on the maintenance of habitat links.

FAUNA

Rare or Threatened Fauna

Ba 10^c: Southern Lined Earless Dragon. One was observed in a rock wall at the eastern boundary of Craigieburn Grassland with Hendon Park on 4 March 1990. The habitat was open Kangaroo Grass plains grassland (23.2) on the Craigieburn Grassland side (lightly grazed by sheep) and very open wallaby-grass grazing land on the Hendon Park side. Scattered areas of Kangaroo Grass stony knoll grassland (22.1) were also present. The species inhabits rock outcrops amongst grassland that would have originally been kept naturally open (see Plains-wanderer). The combination of rock walls and stony knolls enable it to persist in sheep grazing land. The north-central silt plain/stony barrier section where the Plains-wanderer was observed supports a similar open grassland/rocky grassland combination.

The Southern Lined Earless Dragon is a very difficult animal to observe as it is small, alert and able to flee quickly into rock crevices or holes in the ground (see site 4). An unconfirmed sighting along Harvest Home Road to the east in site 13 was made in January 1993 (Nick van Rosendaal pers. comm.). It is a considered view of grassland herpetologists that the dragon is on the brink of extinction in Victoria and possibly Australia (Peter Robertson pers. comm.). Studies including pitfall trapping, research and habitat assessment at Craigieburn Grassland are a matter of urgency.

Bb 10^a: Plains-wanderer. One was seen while spotlighting sheep grazing land (ex-23.2) on a silt plain separated by parallel barriers of stony rises in the north-central section of Craigieburn Grassland on 28 August 1991. A male was located in the same area with a nest on 23 September 1991. There are a number of historical sightings from NEM. These include Campbellfield, Broadmeadows, Epping and Wallan. It is documented that birds were in 'tolerably large numbers' and that clutches of eggs were frequently met with on the flat, open Keilor Plains grasslands and at Broadmeadows. Since the 1920s, there are few records, particularly to the north of Melbourne. The main population centre in GM is on the Werribee Volcanic Plains, north of the You Yangs. There were 13 sightings made in this area between 1986 and 1991. Sightings in NEM (four since 1983) were each in broad-acre grazing land.

The grey-black duplex soils at Craigieburn Grassland become water-logged in wet years and very dry over summer, the combined effects making it naturally treeless. The silt plain is flat and lies between two parallel stony barriers. The central area originally supported Kangaroo Grass plains grassland (23.2). The grassland, and more particularly the Kangaroo Grass, was kept naturally open by seasonal waterlogging. In the absence of protection from rocks, cover has been further reduced by livestock to open wallaby-grass grazing land (Common, Short, Brown-back and Bristly Wallaby-grass). This has low stature (20–30 cm tall) and open structure (10–20% cover). The inter-tussock space contains low annual herbs which die back to bare ground in summer. Soils of seasonally damp swales near the base of stony barriers are uniform black cracking clay. These support Brown-back Wallaby-grass seasonal wetland (25.3).

The main habitat of Plains-wanderers in GM has low, sparse grass cover. This may be due to a combination of low rainfall, seasonal waterlogging, exposure/desiccation and eroded or poorly developed topsoil (lower fertility). Light grazing by sheep assists in maintaining the appropriate tussock/open space ratio (see Conservation Measures).

Plains-wanderers are locally mobile over a home range of 10 ha or more. A viable population requires extensive areas of habitat (hundreds of hectares). The diversity and extent of habitat types is the key to the Plains-wanderer being present. The vegetation structure of grassland can vary according to climate and grazing rates. Birds likely utilise other habitats as they become seasonally available. They doubtless visit the extensive areas of wallaby-grass grazing land on broad-acre farms to the east and north-east (sites 13/14). The dry lake and surrounds near Craigieburn Road East may also be of importance. During late summer or droughts, when cover on the silt plains has been removed by livestock grazing, the stony rises and their herbaceous plant/insect diversity may provide foraging areas. Cereal stubbles also provide temporary refuge or food, particularly those containing Prostrate Knotweed.

Plains-wanderers are sedentary as long as sufficient food is available. They move locally in times of food shortage (e.g. late summer–autumn and droughts). They are nocturnal, laying stretched out in a shallow scrape by day, often under a pile of straw or a cone of tussocks pulled together. If approached closely they trot away (hunched over like a dotterel) and take up a squat in another scrape. Plains-wanderers are difficult to relocate on

foot due to their cryptic behaviour and camouflaged plumage. They move freely while foraging and are alert to predators from ground and air. This enables them to utilise areas of open ground cover in which species such as quail would fall prey to foxes and owls.

They do not fly during the day and only at night if harassed or virtually driven over. Flight is short (usually < 50 m) and terminates in a slow, fluttering descent to another squat. Two birds were seen from moving vehicles during the GM survey. On each occasion they flushed and after alighting the bird froze. In one instance (Craigieburn) it could not be relocated. A bird seen on the Werribee Plains in October 1986 was pursued around a circuit of three or four squats. Shooters indicate that gun dogs become disoriented by their scent and circle around between the squats.

The nest of the Plains-wanderer at Craigieburn contained four eggs. These were placed in a shallow ground-scrub in a dry section concealed amongst open Brown-back Wallaby-grass tussocks. The eggs were 'tear-drop' shaped like that of the button-quail and well-camouflaged, light glossy green with brown speckles. Clutches of eggs (usually 3 or 4) have been taken from around Melbourne predominantly in October, but extending through summer when ample rains occur. Presence of the Plains-wanderer in 1991 may be partly attributed to movements of birds from western New South Wales to higher rainfall areas in response to drought. However, another recent sighting (1986) of a Plains-wanderer was made to the north in the Summerhill Road site by a local quail shooter.

The nesting at Craigieburn was probably influenced by favourable local rainfall conditions and availability of seeds and insect prey. In inland Australia they are able to breed opportunistically through the year, determined by conditions which cause a flush of growth and seed production. Little or no breeding occurs during dry years. Similar to the button-quails, the female is more brightly coloured than the male and is polyandrous, leaving the male to rear the young.

Diet of the Plains-wanderer is composed of seeds and insects, taken at night (Blakers *et al.* 1984). Insects are mostly fed to the young (Readers Digest 1986). Seeds include those of pasture and cropland weeds (e.g. Prostrate Knotweed, Bathurst Burr and Saffron Thistle), spilled grain (particularly oats) and legumes (e.g. clovers and medics) in cereal stubbles and seeds and green shoots of native grasses (various shooters pers. comm.). Livestock oaten hay feed-trails may also be utilised.

Populations have declined due to predation (particularly of young) from foxes and possibly cats. Most of the grassland within the former range of the species in south-eastern Australia is under unfavourable management. Changes such as small farm subdivision and increased land-use intensification and encroaching residential development have each had a detrimental effect on populations near Melbourne. Farmland subdivision of broad-acre grazing lands has resulted in more intense livestock grazing regimes. This renders open tussock cover of grasslands to bare ground. Pasture improvements of grassland dominated paddocks such as rock clearing and top-dressing to increase stock carrying capacity is occurring. These processes convert the native tussock grassland into a low pastureland sward. Plains-wanderers do not regularly utilise improved pasture or intensively developed, closely settled farmland.

The prevailing land-use of rural sections of the Merri Plains has been as broad-acre sheep and cattle grazing land (see Conservation Measures under ecological mosaic burning and light grazing option). This non-intensive land-use has maintained suitable open tussock habitat for the Plains-wanderer. The ideal habitat of the Plains-wanderer in southern Victoria contains the combination of blocks of several hundred hectare of grassland (Kangaroo Grass) and seasonal wetland (Brown-back Wallaby-grass) adjacent to extensive areas of unimproved and uncultivated open wallaby-grass grazing land. Conservation of the Plains-wanderer in NEM, due to its behaviour and apparent low population density, will require the retention and management of remaining extensive and linking areas of suitable native grassland habitat. Given the ecological requirements of the species, it becomes evident that a reserve supporting viable populations must be large.

Bb 10^{ab}: Striped Legless Lizard. Two were located under rocks in the north-western section on 15 June 1988 (Martin Schulz pers. comm.). One was in crumbling brown uniform clay on a stony crest (Kangaroo Grass stony knoll grassland; 22.1) and the other was in brown duplex soil on the stony plains (Kangaroo Grass plains grassland; 23.2). Another was located on a stony crest north of O'Herns Road in January or February 1995 (Tim Offor, Greening Australia, pers. comm.). The main population centre in Australia of the Striped Legless Lizard is the volcanic plains near Melbourne. Craigieburn Grassland is considered one of the most extensive and secure

remaining for the species. Other population centres of Striped Legless Lizards in GM are each associated with areas of extensive and intact ungrazed or only lightly grazed, treeless rocky grassland. These include the Derrimut Grassland Reserve and William Angliss land at Derrimut and Live Bomb Range west of Werribee (Beardsell in prep.).

The Striped Legless Lizard belongs to a predominantly inland (Eyrean) genera and family. The Kilmore Gap in the Great Divide links the northern (e.g. Seymour) and southern (e.g. Beveridge) Victorian range of the species. The distribution in Australia follows the low, uniform seasonal distribution rainfall zone of the foothills of the Great Divide and adjacent lowland plains (centred on Victoria). The range is somewhat fragmented and shows distribution clusters (Coulson 1990). These are in the Penola district of the south-east of South Australia, the western volcanic plains near Hamilton, Colac and Melbourne, near Seymour and Kerang in northern Victoria, and Canberra and an outlier to the north in the Hunter Valley.

Substantial populations of the Tussock Skink and Little Whip Snake inhabit the stony crests at Craigieburn Grassland. Sites containing legless lizards near Melbourne generally supported high population densities of these species (Coulson 1990). There is a direct correlation between the density of native grass tussocks and plant litter cover and the presence of the lizard (Coulson 1990; see Conservation Measures under Striped Legless Lizard management, ecological mosaic burning and light grazing option). There also appears to be a correlation with the abundance of embedded rock and the degree of intactness of the native grassland flora, although this may be a secondary relationship as rocky, uncultivated areas generally contain denser cover and a higher proportion of native grassland plants. The primary habitat requirement is mature Kangaroo Grass tussocks which harbour its main food source, the larvae of noctuid moths. This is mainly found in the north-west section of Craigieburn Grassland above the eastern escarpment of Merri Creek.

Striped Legless Lizards are mobile and moderately quick over the ground and readily burrow under rocks and into tussocks. They shelter under rocks during winter–spring and when active during summer–autumn, they utilise grass tussocks or soil cracks. Body temperature relies on contact with the surrounding air and ground temperatures. They are most active during warm, sunny weather and are predominantly diurnal (Peter Robertson pers. comm.).

Two eggs are laid in early summer, hatching in late summer (Coulson 1990). The oviposition sites are unknown (Peter Robertson pers. comm.). Analysis of faecal pellets revealed that the diet at Derrimut Grasslands consists of large soft-bodied insects such as noctuid moth larvae (main component), crickets, grasshoppers and spiders (Coulson 1990). They have been observed taking juvenile Tussock Skinks in late summer.

Few of the known populations of the Striped Legless Lizard in western Victoria are secure as they occur in small habitat remnants along degraded roadside strips or in paddocks (Coulson 1990). Most locations are where the land-use has shifted from a broad-acre farming regime to a more intensive level. This entails rock clearing, higher livestock grazing levels, grassland cultivation for introduced pastures and crops, damming and drainage alteration and increased rates of herbicide, pesticide and fertiliser application. Local population extinctions appear inevitable. Populations in the ACT are now very localised while those in SA are possibly extinct (Coulson 1990).

Populations of the Striped Legless Lizard along Merri Creek are now isolated from the next nearest known populations to the west between Kororoit Creek and Jacksons Creek. Intervening areas of suitable rocky grassland habitat have been eliminated. Rocky grassland links in NEM within the Merri Creek and nearby Edgars Creek systems which contain the Striped Legless Lizard are being fragmented. There has been widespread landscaping, which entailed using earth-moving equipment to remove the surface and deeply embedded rock. The main areas of suitable habitat for the lizard remain on stony knolls. Residential and industrial development, heavy livestock grazing pressure and predation from foxes and cats are threatening the species.

Bc **10^a: Red-chested Button-quail.** An adult male with three newborn young was observed in ungrazed Kangaroo Grass plains grassland (23.2) on the east side of Merri Creek, at the peninsula east of the confluence of Aitken Creek on 11 November 1991. There were only four other sightings in NEM (site 4 at Bald Hill, site 5 at Kalkallo Common, site 14 at Woody Hill Swamp and site 15 at Fenwick Stud). In GM their main population centre occurs on the Werribee Lowland Volcanic Plains where annual rainfall lies between 450–600 mm (six sightings over the last decade). There was a scatter of sightings in higher rainfall upland grasslands towards the

edge of the volcanic plains (e.g. Monegeeta). Their northern Australian range falls largely within the Torresian summer rainfall zone (tropical/sub-tropical) and coincides with the distribution of the summer flowering Red-leg Grass and Silky Blue-grass.

Small numbers of Red-chested Button-quail are annual late spring–early autumn (late October to March) migrants from north-eastern Australia to grasslands north and west of Melbourne. Local irruptions occur during dry conditions in the north on about two to three year cycles. In wet years in the south (e.g. 1970–72) substantial numbers enter (Norm Lawlor pers. comm.). In these years they are likely to over-winter when conditions are mild. They occupy similar habitat to the Little Button-quail, but require larger areas to form coveys. They tend to be a more regular visitor than the Little Button-quail to the grasslands of southern Victoria. Of the two button-quail, the red-chested is the more common and widespread in the extensive volcanic plains grasslands west of Melbourne, but both are rare in the more fragmented grasslands of NEM.

Dense cover provided by sizeable, ungrazed grassland reserves may be vital for the survival of the species. Searches of likely habitat at the Cooper Street Grassland (a dense ungrazed stand of 20 ha) failed to reveal the species. This was probably due to the small area of habitat, unsuitable soil type (predominantly grey-black duplex), proximity of urban development and the higher levels of human disturbance and cats. The exclusion of livestock grazing over patches exceeding 50 ha in the north-western section of the Craigieburn Grassland would encourage larger numbers of this and other cover-dependent species.

Red-chested Button-quails inhabit dense stands of broad-acre (usually exceeding 50 ha), stony knoll and plains grassland which are treeless or contain a light cover of River Red Gums (Plenty Volcanic Plains). On the Merri Plains, they inhabit unimproved, uncultivated and ungrazed or only lightly grazed grasslands. These are dominated by Kangaroo Grass of medium stature (20–50 cm tall) and structure (40–60% cover). Red-leg Grass is also a dominant west of Melbourne. At both Bald Hill and Craigieburn the button-quail occurs near rocky escarpments of Merri Creek. Soils are brown crumbling uniform clay on the stony crests, red gradational on the stony rises and brown duplex on the stony plains. The grass cover and native plant diversity provide shelter and food, particularly during droughts when cover on grazing land has been removed.

The Red-chested Button-quail has rarely been recorded breeding in GM, except during irruption years (e.g. Craigieburn Grassland on 11 November 1991). This irruptive behaviour coincides with several other grassland birds including the Plains-wanderer. Similar to this species, female button-quails are polyandrous, the smaller and less brightly coloured males raise the young. They place their well-camouflaged cup-nest of grass in a scrape in the litter, often concealed in a grass tussock; usually four eggs are laid (Readers Digest 1986). Consecutive broods have been recorded in favourable years.

Their diet consists of small seeds including spilled cereal grain (Blakers *et al.* 1984). In the vicinity of sightings on the Merri Plains, the seeds of summer-flowering native grasses (e.g. Kangaroo Grass and Red-leg Grass) and inter-tussock herbs (e.g. Blushing Bindweed and Yellow Rush-lily) were available. On the Werribee Plains, crop samples have included small, hard seeds of pasture and cropland weeds (e.g. Common Onion-grass, Prostrate Knotweed, Saffron Thistle, Bathurst Burr), adventitious legumes (e.g. clovers and medics) and grain spilled from livestock oaten hay feed-trails (various shooters pers. comm.). Insects are fed to the new-born young by the male and after a week or so he leads them in search of seeds (Readers Digest 1986).

The Red-chested Button-quail, being more dependent on large stands of dense grassland than other button-quails, has been reduced in range and abundance by livestock grazing and cultivation. Most of the grassland within the former range of the species in south-eastern Australia has been rendered unsuitable by cover and food loss. Populations have probably declined due to predation (particularly of young) from foxes and possibly cats.

Bc 10^a: Freshwater Blackfish. One was taken in a cage trap in the Merri Creek above the confluence of Aitken Creek on 4 February 1992. A Common Galaxias (*Ed*) and three Short-finned Eel were also taken in traps baited with fish food and blood and bone. The pool just upstream of the Craigieburn sewage treatment plant outlet may now be the most downstream occurrence of Freshwater Blackfish in the system.

Critical Assemblages or Populations

Dd/Cl **10^a: High diversity of herpetofauna.** Craigieburn Grassland contains the most diverse assemblage known on the volcanic plains of GM. It supports an overlap of species from three zoogeographic regions. Eyrean (inland) species include the Striped Legless Lizard, Plains Froglet, Marbled Gecko, Common Spadefoot Toad and Large Striped Skink. Warm Temperate species include the Eastern Three-lined Skink, Little Whip Snake and Red-bellied Black Snake. Cool Temperate species include the Southern Water Skink, Tussock Skink and Lowland Copperhead (see the Bald Hill site).

Other Significant Fauna

Birds

- Ec* **10^a: Spotless Crake.** One in reed-beds amongst Woolly Tea-tree riparian scrub (18.2) along the Merri Creek downstream of Aitken Creek on 29 January 1990.
- Ec* **10^a: Singing Honeyeater.** One was observed in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) downstream of Aitken Creek on 4 February 1992. It was feeding on nectar and insects in flowering Tree Bursarias. Several were also present by the Hume Freeway in front of the Craigieburn sewage treatment plant, where they were feeding in ornamental flowering mallee eucalypts. The species breeds along the coast and undertakes movements onto the volcanic plains during late summer and autumn. A Spiny-cheeked Honeyeater was also seen along the Merri escarpment in February 1992. It was feeding on ripened fruit of African Box-thorn.
- Ec* **10^a: Zebra Finch.** A flock of three to five birds was recorded in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) downstream of Aitken Creek on 4 February 1992 and 26 October 1993 (breeding). The flask-shaped nest was constructed in a Tree Bursaria. The finch was formerly more widespread on the Merri Volcanic Plains but with the loss of shrubs has become very rare (like the Southern Whiteface; see site 14). If the species is to survive, regeneration of rocky shrublands through grazing protection needs to be promoted.
- Ee* **10^a: Latham's Snipe.** One flushed from reed-beds along the Merri Creek (18.2), 50 m south of Craigieburn Road East on 8 January 1987. In wet years, after arrival in late August–early September, Latham's Snipe visit seasonal wetland meadows of Brown-back Wallaby-grass (25.3) in stony knoll apron swales, gilgais and drainage lines to feed at night. They shelter on mudflats amongst reeds and sedges along the creek during the day and also feed there at night (see also O'Herns Road Wetlands, site 12).
- Ee* **10^a: Striated Fieldwren.** This species was recorded in habitats containing tall grass and a scatter of shrubs (where they breed). The habitats include Lightwood–Tree Violet cliff/escarpment shrubland (20.5) and Common Tussock-grass plains grassland (23.1) when adjacent to stony rises (Kangaroo Grass stony knoll grassland; 22.1) containing Tree Violet and Hedge Wattle. Craigieburn Grassland was the only site where the fieldwren was recorded breeding in NEM. This species was formerly abundant, but has become scarce in NEM. with the loss of shrubs from the volcanic plains.

Mammals

- Ec* **10^a: Fat-tailed Dunnart.** Evidence from recent trapping studies in GM suggests that this species has declined appreciably over the last decade. Several nests were located amongst Kangaroo Grass stony knoll grassland (22.1) in the parallel barriers of stony rises crossing the north-central section of Craigieburn Grassland on 15 June 1988. These were cup-shaped structures of dry grass, about 10 cm in diameter, placed amongst partly excavated tunnels under large flat rocks. The soils were loose red gradational loams. More than ten animals were seen near the base of the stony rises while spotlighting by car on the adjoining silt plain (Kangaroo Grass grassland; 23.2) on 28 August 1991. The species appears to undertake cyclic population fluctuations, or at least detectability rates, depending on climatic conditions. During favourable episodes when prey availability and breeding is optimal they appear locally common. In unfavourable conditions observations are scarce.

Conditions in autumn and early winter 1991 had been dry and cold. During these times the dunnart apparently undergoes a starvation-induced torpor to conserve energy. Rains in July and early August followed by mild weather in late August brought on a growth burst of short grass and an increase in grasshopper populations. These were probably a major prey item of the dunnart, while the ground was still soft enough to scratch for

earthworms and beetle larvae. The food availability mobilised the dunnart and led to the high detection rate of 28 August.

10^a: Habitat link along the creek. The riparian and escarpment vegetation along Merri Creek is of high quality and is an important habitat link for ground mammals. The presence of the locally rare Common Wombat and Black Wallaby (not known from closer in along Merri Creek) suggests that it acts as a faunal corridor. The Common Wombat is close to extinction on the volcanic plains.

Reptiles

Ee **10^{ab}: Red-bellied Black Snake.** Individuals recorded in Woolly Tea-tree riparian scrub (18.2) by Merri Creek at O'Herns Road on 1 February 1989 and downstream of Aitken Creek on 5 May 1989. This section of the Merri appears to support the stronghold of the black snake in NEM. The species has undergone extensive decline with advancing settlement further east along the Plenty/Yarra rivers and Diamond Creek.

Butterflies

Eb **10^a: Chequered Swallowtail.** A migration passed through NEM in late November–early December 1993. On cycles of about five years, butterflies leave the inland and move south. A visit to the Summer Hill drainage line area on 20 December 1993 recorded early instar swallowtail larvae on the Tough Scurf-pea (an endangered species in Victoria). The butterfly had not been previously recorded breeding in GM and was assumed to be a non-breeding vagrant. Several adults and pupae were observed in a return visit on 25 February 1994.

10^a: Merri Creek/Summer Hill drainage line. Searches for butterflies were made at Craigieburn Grassland on 18 October 1988, 4 February 1992, 19 January 1993, 20 December 1993, 25 February 1994 and 30 November 1995. Fifteen native species were recorded. This excludes the migratory Caper White, seen in October 1988 (see Bald Hill site) and is the most diverse grassland assemblage recorded in GM. An adult emergence of Small Coppers and the Pea Blue and Phigalia Skipper were recorded on the plains above the eastern escarpment of the Merri Creek on 18 October 1988. The larvae of the Phigalia Skipper feed on Wattle Mat-rush. This plant is common on the stony plains and stony knolls.

The larvae of the Small Copper feed on the Grassland Wood-sorrel and are known to pupate under rocks (Michael Braby pers. comm.). The adult coppers may have several emergences in favourable seasons but fly in each for only a few weeks. Satyrinids (browns and xenicas) were rare, being represented by only three species (Klug's Xenica, Common Brown and Meadow Argus). The argus was feeding at flowering Woolly Tea-trees on 30 November 1995 while the xenica and Common Brown were observed on 20 December 1993. The argus is locally common and breeds on the introduced century and the native Narrow Plantain.

The Double-spotted Line Blue (common) and Dispar Skipper were seen in the flowering Tree Bursarias on 4 February 1992 and 19 January 1993. The larvae of the skipper feed on a range of grasses and the Wattle Mat-rush while those of the line blue feed on ground peas and small wattles. A single Symmomus Skipper was observed on 25 February 1994. The larvae feed on Spiny-headed Mat-rush, restricted to the creek escarpments.

10^b: Electrofishing Survey: Merri Creek Site 5. O'Herns Road ford

Map reference. 7822 197330. **Altitude.** 140 m. **Survey date.** 1 February 1989

Vegetation. Instream: submerged and emergent herbfield (good condition). Bank: Woolly Tea-tree riparian scrub (18.2; good condition). Frontage. Lightwood–Tree Violet cliff/escarpment shrubland (20.5; fair condition; alien shrubs include Gorse, Sweet Briar, African Box-thorn and Montpellier Broom and herbs include Yorkshire Fog, Spanish Artichoke, Spear Thistle and Chilean Needle-grass)

Physical Features:

Pools

Substrate. Deep silt and basalt boulders on basalt base

Maximum size (mid-summer). 8 m wide by 1.5 m deep by 30 m long

Riffles

Substrate. Basalt boulders and cobbles on basalt base; sections of tessellated pavement

Flow (mid-summer low): Size. 3.0 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 14.3 ML/day. Some input of urban runoff from Craigieburn and outflow from Craigieburn sewage

treatment plant. The flow rate increased noticeably from upstream. Allowing for Craigieburn, there was little other surface input. The flow appears to be supplemented by groundwater

Water quality

Summer: Temperature. 23.5°C. **Conductivity.** 1500 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (12); migratory sub-adults. Flat-headed Gudgeon (1); likely breeding resident

Alien species numbers/status. Goldfish (50); likely breeding resident. Mosquito Fish (50+); likely breeding resident

Other comments. The absence of the Southern Pigmy Perch from the system may be due to high water salinity. Roach, which are abundant at the downstream end of the Merri Creek gorge at Barry Road, were not recorded. They appear to be absent from sections of the stream where minimum flow velocity exceeds 0.4 m/second.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. There is an intact riparian habitat link upstream to the Craigieburn to Donnybrook site, an intact overland link east to the Edgars Creeks Headwaters site and a relatively intact overland link north to the Summerhill Road site. There is a riparian link south to the Cooper Street site but overland links have been constricted. Links to the west have been cut by the Hume Freeway and recent industrial and commercial development.</p>	
<p>Scenario for the regional extinction of volcanic plains grassland. The natural heritage of the original estimated 1 million hectares of Western Volcanic Plains grassland now rests with only a few thousand hectares that contain representative flora and fauna. Only a few hundred hectares occur in areas reserved for conservation, and only the Derrimut Grassland Reserve has conservation of both flora and fauna as a management priority (Stuwe 1986, Frood 1992). Volcanic plains grassland is the most threatened vegetation in Victoria. None is represented in a reference area of any description.</p> <p>The most intact and extensive areas of volcanic plains grassland remaining in GM at the commencement of the study in 1986 were the Derrimut Grasslands, Taylors Lakes–Sydenham Grasslands and Craigieburn Grassland. Craigieburn was the most diverse and biologically significant of the three. Taylors Lakes–Sydenham has been eliminated by housing. Derrimut has been fragmented by industrial development and the Western Ring Road. Incremental threatening processes are occurring throughout. Urban development and farming intensification (e.g. rock removal) may in time eliminate most of the native rocky grassland in the Merri Valley.</p>	<p>It is imperative that volcanic plains grassland communities of the level of significance of Craigieburn Grassland are protected and placed under conservation management. Research behind the discovery of rare grassland flora and fauna at Craigieburn Grassland and all other sites in NEM) took comprehensive effort and planning. The following conclusions provide the best possible scenario for conservation of the flora and fauna of Craigieburn Grassland. The issue is fundamentally simple: its preservation will benefit future generations of human and animal kind. Survival of the grassland flora and fauna depends on whether or not the relevant authorities choose to act upon these guidelines.</p>

High levels of livestock grazing. The high level of sheep grazing frequently conducted at the Craigieburn Grassland is considered incompatible with maintaining the conservation values of most grassland flora and fauna species. Legumes such as the Tough Psoralea are at risk of elimination. Episodes of heavy stock grazing have resulted in substrate damage and weed invasion of low-lying freshwater meadows and the Summer Hill drainage line when the ground is wet. There has been a selective loss of cover (particularly palatable herbs) and probably the associated fauna such as the Striped Legless Lizard and Red-chested Button-quail.

Chilean Needle-grass, Serrated Tussock and Gorse advance. This is a major problem. Similar to the Pakenham Blue Metal land (see Summerhill Road site), the Craigieburn Grassland has had periods of intense sheep grazing (e.g. 1989 to 1992). During this period Chilean Needle-grass entrenched in low-lying areas and Serrated Tussock established on stony crests. Gorse has taken over sections of the eastern cliff/escarpments of Merri Creek.

Habitat link fragmentation and encroaching urban development. This is restricting the movements of grassland ground fauna. Populations are becoming isolated. Increased traffic on Craigieburn Road East will partially sever the important northern link for reptiles. The Hume Freeway has fully severed the link to the west. The main habitat of the Striped Legless Lizard near Melbourne has been eliminated by residential and industrial development. This species will be severely affected if surrounding areas at Craigieburn undergo residential, industrial and roadway development. Dispersal of the ground fauna will be further restricted and habitat refugias may no longer be sufficient to maintain viable populations. Without effective management, grassland species such as the legless lizard and Southern Lined Earless Dragon are at risk of local extinction in the short term (and potentially other fauna in the long term).

Scientific research and land management and conservation plans for threatened species and habitats. Management of Craigieburn Grassland needs to contain guidelines for the specific conservation management requirements of threatened habitats and species. Faunal species include the Red-chested Button-quail, Plains-wanderer, Southern Lined Earless Dragon and Striped Legless Lizard. Conservation of these species due to their behaviour and apparent low population density, will require the retention and management of all the remaining extensive and linking areas of suitable native grassland habitat in the site. The other main asset of Craigieburn Grassland is the diversity of plant and animal communities. Interactive ecological research is a necessary tool for preservation and enhancement of these communities. Overall management of Craigieburn Grassland needs to cater for the differing ecological requirements of these communities and species.

Strengthen Strategic Habitat Links. Native grassland habitat links to Craigieburn Grassland need to be protected. Faunal connectivity of the Craigieburn Grassland depends on retaining and strengthening the Strategic Habitat Links east to site 13 and north to sites 11 and 14., accompanied by the development of a habitat protection incentive scheme. The latter could be achieved through rate rebate for compliant landowners. The most critical link is east to the Edgars Creek Headwaters site. Regeneration of River Red Gum and protection of native rock in this area is essential.

Strategic Habitat Linkage is recommended for Craigieburn Grassland with the Cooper Street, O'Herns Road Wetlands, Edgars Creek Headwaters, Craigieburn to Donnybrook, Summerhill Road and Bald Hill sites. If the Hernes Swamp site were added, it would form the most substantial, diverse and significant volcanic plains conservation area in Australia.

Farm subdivision and intensification. Land-use along the Merri is shifting from broad-acre farming regimes to more intensive levels, which are predominantly deleterious to grassland ground fauna species. These shifts include rock clearing, higher livestock grazing levels, grassland cultivation for introduced pastures and crops, damming and drainage alteration and increased rates of herbicide, pesticide and fertiliser application.

Pursuit of Craigieburn Grassland as a biological reserve/Establishment of a Volcanic Plains Ecological Reference Area (ERA). See Appendix 2.1.

Regional Hydrological Strategy

Declining water quality and weed invasion of creek. Earthworks disturbance and habitat loss from industrial development to the west of Merri Creek is causing weed invasion and increased levels of water turbidity. These, accompanied by other factors such as water pollution from upstream rural and urban development (particularly regional sewage treatment plant outfalls) are contributing to loss of biological values of the stream. For example the Freshwater Blackfish, which was known to occur at O’Herns Road in the 1970s, was not located during a fish survey in February 1989. It persists in the Merri Creek in pools upstream of Aitken Creek and the Craigieburn sewage outfall.

Electrofishing site at O’Herns Road. The water quality noticeably declined from that upstream at Summerhill Road (site 11), no doubt affected by urban runoff and treated sewage effluent from Craigieburn. There was high summer water conductivity (and likely salinity) and temperature levels. Poor farmland management in the catchment allowed stock access to streams and swamps and clearing and degradation of native vegetation. Industrial/commercial development was encroaching above the west bank.. The River Red Gums and Drooping Sheokes were declining, there was weed and vermin advance and some bank erosion—slumping.

Environmental Impact Assessment required for any development within or adjacent to the streamway. Any new developments such as regional sewage treatment plants, freeways and infill tips which may compromise these values require full environmental impact assessment.

Water quality and seasonal instream biological studies of Merri Creek. Monitoring surveys for fish, mammals and invertebrates are required to assess the effects of catchment land-use. Rare aquatic mosses (including *Fissidens berteroi* and *Drepanocladus aduncus*) are present along Merri Creek. A study of aquatic bryophytes should be conducted. Hydrological research would include water salinity/conductivity (surface and sub-surface), watertable level and water retention rate in surrounding catchments. Research in Merri Creek would include water salinity/conductivity, substrate and water chemical (organic and inorganic) composition, seasonal flow and water temperature indices, water quality and contaminant assessments including dissolved oxygen, bacteria and algae (enrichment indicators), trace metal levels and other relevant physical and hydrological parameters. Some of the above are ‘socio-economic’ parameters, linked with urban growth (e.g. chemical and biological pollution).

Other Issues

Illegal reptile collection. Rocks have been systematically overturned in sections of the grassland north of O’Herns Road. The extent of the activity suggests reptile traders and not amateur collectors. The remoteness of the area and lack of access would also restrict the latter group. This illegal activity, which appears to have increased with the publicity attached to the Merri Creek grasslands, will require surveillance. A concern is that the discovery and raised awareness of the area’s conservation values has exposed the lizards to the undesirable aspects of public life.

Illegal plant propagule collection. Over the last few years plant collectors have been indiscriminately taking cuttings, seed and some transplants from the creek escarpment. The Smooth Grevilleas and Drooping Sheokes have been heavily stripped. Some of these plants have been propagated for worthy projects but collection of rare plant material must be prohibited from Craigieburn Grassland except for replanting within the grassland. A rationalisation of volcanic plants propagation is required or important species such as the grevillea will be lost from their sites of natural occurrence. Sources of captive populations of volcanic plains propagules need to be established.

Kangaroo trapping. The Eastern Grey Kangaroo has returned to the grassland after 100 years absence. Management of the grassland area will need kangaroo grazing. On a recent visit snares of looped fencing wire were discovered to the south of O’Herns Road. This illegal and inhumane activity will need surveillance.

Placental predator populations. Foxes are at levels high enough to cause significant impact on ground fauna, particularly the Plains-wanderer and Southern Lined Earless Dragon.

Surveillance of reptile and plant propagule collecting and kangaroo trapping.

Native vegetation/rock clearance controls of grasslands.

Grevillea management. Grevilleas should not be used in nearby plantings unless of indigenous stock of the Rosemary Grevillea. This may avoid cross pollination (by bees and honeyeaters) and hybridism with the local population. Hand pollination should be considered to ensure maintenance of genetic integrity. Seed from the local stock needs to be collected and grown. Recruitment of plants or establishment of grown seedlings and cuttings needs to occur around the present colony on the eastern escarpment of the creek. The plants should be fenced from rabbits and protected from unauthorised propagule collectors.

Public interpretation. Given that the Craigieburn Grassland lies near residential growth areas, but within an extractive buffer area, not zoned for residential purposes, it has high potential for rehabilitation and management for public appreciation of faunal values.

Conservation Measures for Managing the Grasslands to Optimise Flora and Fauna
Protection

Striped Legless Lizard management—no grazing/burning option. Conservation of the Striped Legless Lizard and Red-chested Button-quail (and most fauna species present) at Craigieburn Grassland requires the area to remain unburnt and to be protected from livestock grazing. The Striped Legless Lizard occurs on stony knolls and likely the rocky eastern escarpment of Merri Creek. The latter is the area least subjected to grazing impact. Optimal management for the lizard would require the protection of stony knolls from stock grazing so as to develop extensive stands of grassland.

During visits between 1987 and 1992, the area was found to have been under the influence of drought or chronically overgrazed. The dense grassland resulting from the wet spring of 1992 and summer of 1992/1993 leaves little doubt that Craigieburn Grassland should not be grazed or indiscriminately burnt. The diversity and population density of grassland birdlife was the highest recorded and included the Swamp Harrier, Zebra Finch, Singing Bushlark and large numbers of Stubble Quail and Brown Songlarks, all being afforded ample food and cover. These and the Red-chested Button-quail and Striped Legless Lizard are dependent on cover.

The highest population densities of Striped Legless Lizards at Derrimut Grassland Reserve occur in dense stands of long-unburnt grassland. Recent burning regimes to maintain diversity in plant community structure and floristics at this area have been unfavourable to the Striped Legless Lizard. Long-term conservation management of the lizard requires fewer fires so as to ensure dense, continuous grass cover (Peter Robertson pers. comm.). At least 50% of the rocky grassland area at Craigieburn Grassland (preferably several patches) should remain unburnt and be principally managed for the legless lizard (see next section). Conservation of the species would require the cessation of livestock grazing (refer later section).

Ecological mosaic burning and research of the north-central meadows and Summer Hill drainage line floodplain. On flora and fauna grounds, it is recommended that livestock grazing be removed from Craigieburn Grassland (see next section). As a result of increased areas of grass, a grassfire prevention strategy needs to be formulated to protect farmland and potential urban growth areas to the south and east (see Edgars Creek Headwaters, site 13). Hot grassfire over a wide area is also considered deleterious for the conservation of grassland fauna at Craigieburn Grassland. A paradox is that in the absence of grazing, fire regimes are considered of critical importance to the maintenance of populations of most species of grassland plants.

Periodic early summer to late autumn burning of grassland mosaics, leaving ample unburnt habitat, is considered the most desirable mode of grassland habitat management. This maintains structural and floristic diversity within the grassland and reduces the fuel load and risk of hot summer grassfire. Plains grassland without the implementation of periodic burning favours a few dominant closed tussock grassland species (e.g. the native Kangaroo Grass and Common Tussock-grass and introduced Chilean Needle-grass and Toowoomba Canary-grass). Carefully timed burning may also assist in controlling the spread of the needle-grass.

The Plains-wanderer inhabits low, open grassland maintained by livestock grazing on a silt plain in north-central Craigieburn Grassland. In absence of grazing, it may also benefit from periodic burning. Habitat of the Plains-wanderer was presumably maintained in plains grassland prior to European settlement by marsupial grazing and fires (Lunt 1990). Summer fires were caused by lightning strikes and burning-off by Aborigines to maintain food plant and herbivorous marsupial game populations.

Large grassfires are undesirable for the Striped Legless Lizard. Fires conducted at high frequency between late autumn and late spring to enhance herbaceous plant diversity in rocky grassland at Laverton North Grassland Reserve in the 1980s were also unfavourable (see Beardsell in prep.). Hibernating animals were caught in the base of dense grass tussocks by fires at Derrimut Grassland Reserve during seasonally dry and mild conditions in August 1988. The lack of unburnt refugia exposed the animals to food and cover shortage and high levels of predation from birds and foxes (Coulson 1990). Traplines installed in January 1989 at Derrimut in these sections had low capture rates. Autumn burning should be restricted to black and grey cracking soils of the meadows and drainage lines as the cracks provide an escape from fire for small ground fauna.

A prerequisite of grassland community management and conservation is the retention of a mosaic of open and dense tussock stands. In the absence of livestock grazing and adequate natural grazing regime, dense stands of unburnt plains grassland may lack open space inter-tussock fauna (e.g. Plains-wanderer). Strip burning trials are needed in the south-east section with full assessment of their impact on native flora and fauna.

Prescribed burns (for vegetation) in areas likely to contain Striped Legless Lizards should not be conducted at frequencies less than 5 years. Early summer burning appears less harmful as this provides time for cover to return for the late summer hatchlings. A mosaic of unburnt and regrowth stands should be achieved in prescribed burn sections. These should be confined to narrow strips and small patches, provided no more than 20% of the total area of grassland is burnt in a single year. Burning of larger strips may provide inadequate amounts of unburnt habitat for the Striped Legless Lizard (Coulson 1990).

Cessation of livestock grazing. This is considered essential for conservation of most of the rare or threatened plants (VROT species) in the site. Stock exclusion must be continued from Merri Creek. This study also proposes exclusion from Summer Hill drainage line floodplain and terraces and widespread areas of significant grassland. It is also necessary to protect rocky grassland areas in the north-western and south-eastern sections of Craigieburn Grassland for the conservation of Red-chested Button-quail and Striped Legless Lizard.

An ecological study on the effects, both positive and negative, of a light grazing regime by sheep, cattle or horses in the northern meadows needs to be investigated. It is a widespread view amongst grassland ecologists that sheep grazing is keeping the spread of Chilean Needle-grass in check (see Widespread Threatening Processes in Volume 1). This and the address of alternatives to control the needle-grass need to be researched as a matter of urgency.

There is also a view that cessation of grazing may contribute to a reduction of habitat for open ground fauna such as the Plains-wanderer. Intuitively the ample areas of open wallaby-grass grazing land on adjoining farmland negate this as a limiting factor for the Plains-wanderer (see Fauna: **Bb**). In the event of continued grazing, fencing (e.g. mobile electric fences) would be needed to protect rocky grassland habitat of the Red-chested Button-quail and Striped Legless Lizard. Fences would also be needed to protect significant stony knolls, freshwater meadows and Summer Hill drainage line.

Any grazing at Craigieburn Grassland should be light and restricted to a time of less damaging impact to native flora and fauna (e.g. December–April). Cattle are more selective than sheep and tend to leave a lumpy sward of tussock bases. Sheep eat vegetation (including Chilean Needle-grass) down to ground level and overstocking, even for short periods during summer, reduces grassland to bare ground. Cattle and horses seldom eat needle-grass and ground disturbance caused by them spreads the weed. Cattle have a greater tendency than sheep to wade and wallow in soft meadows causing severe pugging and damage to mudflats and herbfields.

Grazing over early summer for one or two months prior to the fire season may be all that is required for fire prevention in years of fire danger or heavy grass growth (e.g. dry summers such 1996/97 after productive growing seasons from heavy winter–spring rains). The employment of heavier pulse grazing may be useful for weed control (e.g. Chilean Needle-grass). Most years, grazing may not be necessary. Should grazing continue at the grassland, a broader stock exclusion zone (extending at least 100 m) will be essential along the full length of the eastern escarpment of Merri Creek and both sides of Summer Hill drainage line. Scientific monitoring of floristic and faunal changes in the reduced-grazing zones, grazing-free zones and control burn mosaics should be implemented to provide information on the effectiveness of each program.

Land protection and conservation management incentives. The significance of the grassland necessitates immediate land protection and conservation management procedures to be undertaken. With selective weed eradication, plant re-introductions, natural regeneration, ecological burning and reduced grazing pressure, partially degraded areas at Craigieburn Grassland have potential for restoration to their natural condition. Resource allocation and strategic planning from the State Government, Whittlesea Council and research and conservation interest groups needs to be directed towards informing surrounding landowners of the importance and need for conservation management of native grassland.

Land protection—weed control/indigenous plantings. Priority removal of African Box-thorn, Gorse, Sweet Briar and Serrated Tussock from stony crests and creek escarpments and Chilean Needle-grass from low-lying areas is required. Planting of appropriate indigenous stony knoll grassland species (22.1), cliff/escarpment shrubland species (20.5) and plains grassland species (23.1/23.2) should commence. Riparian shrubs and River Red Gums (18.2, 30.1) should be re-established along Summer Hill drainage line. Revegetation implies the cessation of livestock grazing, or in lieu, fencing of stony knolls, depressions and drainage lines.

Outbreaks of Spanish Artichoke and Montpellier Broom are presently controllable, but there is potential for these to spread, along with invasion from nearby infestations. Fences and the steep terrain have partially protected the eastern creek escarpment from heavy grazing. Commercial/industrial development has been restricted to the west side of the creek. Careful buffer management of the creek and adjacent open space in industrial/commercial estates to the west from external disturbance will be required. All plantings used for screening should be indigenous species. Compatible management of connecting habitat links needs to be undertaken (see Edgars Creek Headwaters site).

Site 11 Craigieburn to Donnybrook

- Map Reference:** 7822 192364 to 7822 196429 (Merri Creek). One minute lat/long grids include 37° 33' x 144° 57', 37° 34' x 144° 57' and 37° 35' x 144° 56' to 144° 57'.
- Location/Size:** A strip following the Merri Creek from Craigieburn Road East to Donnybrook Road. Approximately 750 ha.
- Municipality:** Cities of Whittlesea and Hume.
- Land Tenure/Use:** Public: V Line reserve along the North Eastern Railway. Private: mostly zoned rural. Sections of the creek between Craigieburn Road East and Summerhill Road are owned by Craigieburn Clay. These are zoned extractive. Remainder broad-acre farm settlement with sheep and cattle grazing.
- Landforms:** Foothill and volcanic plain (see MLVP C). Elevation is 170–220 m.

Natural Heritage Values

Landscape. Extensive areas of moderately intact volcanic plains landforms including stony rises and stony plains and one of the most intact sections of volcanic plains creek and escarpment in GM.

Scientific and Educational Values

Invertebrates. Fauna at the Summerhill Road instream invertebrate study site were indicative of nutrient enrichment (Campbell *et al.* 1982). This is characteristic of streams with extensive rural catchments and indicative of the effect of paddock nutrient runoff and township effluent. This section of Merri Creek is upstream of urban residential/industrial development. Water and instream/riparian habitat quality was higher and instream invertebrate fauna more diverse than urban sections of the stream (Campbell *et al.* 1982, EPA 1984). The substrate/vegetation was in fair condition and supported mayflies (Ephemeroptera), stone-flies (Plecoptera), freshwater shrimp (*Paratya australiensis*) and Oligochaete worms (tolerant of nutrient enrichment).

Scientific reference. Electrofishing site and instream reference point on the Merri Creek at Summerhill Road.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: Woolly Tea-tree riparian scrub (18.2)

Relatively intact and extensive stands: Lightwood–Tree Violet cliff/escarpment shrubland (20.5)

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1); **River Red Gum (plains) drainage line woodland (30.1);** Kangaroo Grass stony knoll grassland (22.1); Kangaroo Grass plains grassland (23.2); Brown-back Wallaby-grass seasonal wetland (25.3); intact stands of 22.1 and 23.2 along the North Eastern Railway reserve prior to earthworks to 1986/87

Remnant, degraded or establishing stands: Golden Wattle–Wedge-leaf Hop-bush cliff/escarpment shrubland (20.4)

Endangered, vulnerable or rare species: unsurveyed; the endangered Small Golden Moths and Button Wrinklewort occurred along the North Eastern Railway reserve south of Summerhill Road; these along with the regionally threatened Lobe-seed Daisy, Minnie Daisy and Woolly New Holland Daisy (each extinct in NEM) were eliminated by a rail maintenance track in 1986/87

Critical assemblages or populations: Strategic Habitat Link

Notable features: reference stand of Woolly Tea-tree riparian scrub downstream of Summerhill Road. The basalt cliff/escarpment shrubland is relatively intact. Escarpments behind Craigieburn Clay and downstream of the railway bridge contain small sedimentary outcropping. These support Drooping Sheoke, Wedge-leaf Hop-bush, Rock Correa and Sticky Boobiella. Farmland stony knolls and plains fronting the North Eastern Railway contain extensive sections of partially degraded grassland and small stands of mature River Red Gums. Plump Spear-grass persists along the railway reserve south of Summerhill Road.

FAUNAL SIGNIFICANCE: Site 11 Craigieburn to Donnybrook

Assessment: State—Category 3 (B); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

11^a: 37° 34' x 144° 57'; Merri Creek/North East Railway at Summerhill Road

11^b: 37° 35' x 144° 56'; Malcolm Creek at Craigieburn north

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 11^a: Striped Legless Lizard (one on the Merri Creek escarpment midway between Summerhill Road and the North East Railway bridge on 28 November 1991)

c. Rare fauna

Regional. 11^a: Lewin's Rail, Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 11^b: 4 species triplined including the White-striped Freetail Bat on an upstream arm of a dam on Malcolm Creek on 16 May 1991

l. Reptiles

Regional. 11^a: 10 species including the Marbled Gecko, Southern Water Skink, Striped Legless Lizard, Little Whip Snake, Red-bellied Black Snake and Lowland Copperhead in a 4 hour search to both sides of Summerhill Road on 28 November 1991

m. Freshwater fish

Regional. 11^a: 2 species (Short-finned Eel and Flat-headed Gudgeon; one of each electrofished from the Merri Creek at Summerhill Road on 1 February 1989)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 11^a: over 90 species

b. Native birds

Regional. 11^a: over 60 species

c. Native mammals

Local. 11^{ab}: 5 species

d. Herpetofauna

Regional. 11^a: 19 species

e. Freshwater fish

Regional. 11^a: 3 species (Short-finned Eel, Freshwater Blackfish and Flat-headed Gudgeon)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 11^a: 14 species

b. Regionally endangered fauna (R1 species)

Regional. 11^a: 1 species. **Reptiles**: Striped Legless Lizard

c. Regionally vulnerable fauna (R2 species)

Regional. 11^a: 4 species. **Birds**: Lewin's Rail, Diamond Firetail. **Fish**: Freshwater Blackfish, Flat-headed Gudgeon

d. Regionally rare fauna (R3 species)

Regional. 11^a: 2 species. **Birds:** Little Corella. **Reptiles:** Marbled Gecko

e. Regionally depleted fauna (R4 species)

Regional. 11^a: 7 species. **Birds:** Latham's Snipe, Whistling Kite, Rainbow Bee-eater, Striated Fieldwren, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** Red-bellied Black Snake

f. Regionally restricted fauna (R5 species)

Regional. 11^a: 9 species. **Birds:** Cattle Egret, Barn Owl, Brown Songlark. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, Tussock Skink, Little Whip Snake

Local. 11^b: 2 species. **Reptiles:** Tussock Skink. **Frogs:** Common Spadefoot Toad

g. Nesting birds of prey/parrots

Regional. 11^a: Wedge-tailed Eagle in a River Red Gum upstream of Summerhill Road on 28 November 1991

F. POPULATION DENSITY: Viability and Abundance—point census

i. Bat trapping rate

Regional. 11^b: 12 bats of 4 species triplined on an upstream arm of a dam on Malcolm Creek on 16 May 1991

l. Regionally vulnerable fauna (R2 species)

Regional. 11^a: Diamond Firetail (6 birds in cliff/escarpment shrubland near Summerhill Road on 28 November 1991; two breeding pairs); Flat-headed Gudgeon (5 electrofished at Summerhill Road on 15 December 1988)

Outlook

There is extensive habitat for the Striped Legless Lizard backing the escarpments. The herpetofauna significance and intactness of riparian and escarpment vegetation requires that the site receive increased levels of conservation management. The streamway Strategic Habitat Link to Craigieburn Grassland must be protected.

FAUNA

Note. Poor access made the site difficult and the survey was limited to brief visits. Additional frogs and reptiles would be recorded with extensive searching. The site is likely to support State significance values for herpetofauna diversity.

Bb 11^a: Striped Legless Lizard. One observed under a rock on a stony crest in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) at the top of the eastern escarpment of the Merri Creek, midway between Summerhill Road and the North Eastern Railway bridge on 28 November 1991. Protection from grazing of grasslands on frontage stony knolls (22.1) and shrublands on the stream escarpment may be critical for the survival of the lizard.

Bc 11^a: Lewin's Rail. One midway between Summerhill Road and the North Eastern Railway bridge west of Woody Hill in reed-beds amongst Woolly Tea-tree riparian scrub (18.2) of the Merri Creek on 28 November 1991. The rail was largely recorded in sedgeland and reed-beds along streams or nearby floodplain swamps and billabongs in NEM. Observations were mainly spring–summer, suggestive of migratory or more possibly nomadic behaviour. They are possibly resident in some areas and the seasonality is due to them becoming difficult to detect (or inadequately searched for) during winter in their dense marshland habitat. Juveniles likely disperse in autumn–winter into seasonal and coastal wetlands on the plains. Possibly wintering birds of the Tasmanian sub-species enter GM at this time. Inland birds probably settle in southern Victoria during droughts.

Lewin's Rails develop runway systems through their sedgeland habitats. They are constantly active, skulking and darting in and out of cover and along their runways under low vegetation. They probe for invertebrates in soft ground, mud or shallow water and amongst low herb foliage and litter. They also probe in crevices and under debris for invertebrates. Small crustaceans (e.g. freshwater shrimps and shell-shrimps), insects, molluscs and a small amount of herbage comprise the diet (Reader's Digest 1986).

Livestock trampling and grazing of herbfields along streams and at wetlands has depleted the range of this species in GM. Protected watercourses in gorges of the Merri Creek and Plenty River which support dense herbfield and shrubland form the principal habitat of the species. Continued protection from grazing along the streamway may be critical for the Lewin's Rail. They are prone to predation from cats and foxes. Declining water quality of the Merri Creek is a concern for the Lewin's Rail and Platypus (see *Ee*).

Bc **11^a: Freshwater Blackfish.** Occasionally caught in the pool upstream of Summerhill Road (Evelyn Draper pers. comm.). Populations of this species appear absent from downstream of Craigieburn, probably because of water pollution. Moderately high conductivity (indicative of salinity) levels were recorded at the Summerhill Road bridge during the electrofishing survey. The apparent absence of the Southern Pigmy Perch from the Merri Creek system, and more particularly this section, which supports the most suitable habitat, may be linked with the water salinity.

Other Significant Fauna

Birds

Ec **11^a: Diamond Firetail.** Six birds seen amongst Woolly Tea-tree riparian scrub (18.2) and Lightwood–Tree Violet cliff/escarpment shrubland (20.5) on the Merri Creek terrace and escarpment near Summerhill Road on 28 November 1991. There were two breeding pairs, the nest of one was located in a Tree Violet thicket.

Ee **11^a: Latham's Snipe and Rainbow Bee-eater at Summerhill Road.** Both recorded along the Merri Creek on 28 November 1991. The Rainbow Bee-eater was breeding in the escarpment (20.5) upstream of the bridge. A Latham's Snipe was seen on the tessellated pavement/terrace (18.2) downstream of the bridge.

Eg **11^a: Nesting Wedge-tailed Eagles.** A pair with one young on the nest was seen in a River Red Gum (18.2) along the creek upstream of Summerhill Road on 28 November 1991. The adults foraged over the creek gorge for rabbits and ranged into River Red Gum grassy woodland (14.1) to the east in the Summerhill Road site for other prey (e.g. carrion). They are the last nesting pair along the Merri Creek. The secluded creek gorge and grassy woodland provide the most ideal habitat combination remaining for them. This is also one of few known nesting pairs of Wedge-tailed Eagles remaining on the volcanic plains of NEM (see site 20). Several others between the Plenty River and Merri Creek have ceased nesting due to nest-site disturbance. The Merri Creek pair should not be disturbed during spring. The seclusion provided by the area must be maintained if the eagles are to remain.

Mammals

Ee **11^a: Platypus.** One was observed foraging in the deep pool upstream of Summerhill Road on the evening of 24 November 1991. The Woolly Tea-tree riparian scrub (18.2) and associated emergent herbfields of riffles, pools and terraces at Summerhill Road are along with those at Craigieburn Grassland, the most intact in the Merri Creek. The section contains the only known population of the Platypus in the Merri Creek. The diversity of instream vertebrate fauna at Summerhill Road supports the findings of Campbell *et al.* (1982) and is indicative of fair water quality. The freshwater shrimp (*Paratya australiensis*) was recorded by Campbell *et al.* (1982). This is an important food of the Platypus, as is the regionally threatened freshwater crayfish (*Engaeus quadrimanus*), which has been recorded immediately upstream and downstream (sites 5 and 10). Oligochaete worms, which are also important prey, were common (see site 35).

Platypus have been eliminated from lower sections of Merri Creek and are possibly heading toward extinction in the system. The surviving population at Summerhill Road is small and isolated from those in the Yarra and inbreeding and lack of recruitment likely occurs. Other threats include the effect of nutrient enrichment, salination and siltation from farmland and township (e.g. sewage treatment plant) runoff on instream herbfields and invertebrate prey (e.g. crustacea and insects with aquatic larvae such as damselflies and mayflies). Loss of overhanging River Red Gums and riparian and escarpment shrubs has also reduced the habitat of offstream invertebrate food. Erosion and loss of bank cover may limit breeding sites of the Platypus. Predation from dogs and foxes may also be a factor.

Reptiles

Cl **11^a: Streamway reptiles at Summerhill Road.** Ten species were recorded in a 4-hour herpetofauna search of Woolly Tea-tree riparian scrub (18.2) and Lightwood–Tree Violet cliff/escarpment shrubland (20.5) to both sides of Summerhill Road on 28 November 1991. Species included the Marbled Gecko, Striped Legless Lizard (see *Eb*), Southern Water Skink, Large Striped Skink, Cunningham’s Skink, Tussock Skink, Little Whip Snake, Red-bellied Black Snake and Lowland Copperhead. A Common Long-necked Tortoise was observed in a pool at the Summerhill Road bridge on 24 November 1991. The rocky stream terraces and cliffs support the main assemblage of reptiles in the site.

Frogs

11^a: Growling Grass Frog. Locally common along Merri Creek. Twenty calling in pools amongst Woolly Tea-tree riparian scrub (18.2) on 24 and 28 November 1991 and several located under damp rocks on the terrace and at the top of the escarpment amongst Lightwood–Tree Violet cliff/ escarpment shrubland (20.5) on 4 July 1988.

Ec **11^a: Flat-headed Gudgeon.** The five electrofished at Summerhill Road on 15 December 1988 comprised one of the highest returns of the species during the electrofishing survey of NEM. They were consistently recorded only in rocky rapids supporting riparian scrub (18.1/18.2) in the Plenty River gorge (sites 40–42) and Merri Creek gorge (sites 10 and 11).

Flat-headed gudgeon lie on the sand or mud substrate amongst small stones and boulders in rocky riffles and shallow pools with clear running water. In spring and summer the female lays eggs in a single cluster attached to the surface of small rocks. This spawning strategy makes the eggs susceptible to mortality from increased sediment in farmland/urban runoff (Tarmo Raadik pers. comm.). The eggs are guarded and fanned by the male.

Flat-headed Gudgeon are small, slender and elongate fish with large eyes and mouth. They spend much of their time laying motionless and cryptic on the substrate. Like most bottom-dwellers, the pectoral fins are relatively large and the fish are capable of short, rapid bursts of speed when pursuing prey or escaping from predators. They feed on small fish, tadpoles, crustacea and aquatic insects (Cadwallader & Backhouse 1983).

Freshwater fish

11^a: Electrofishing Survey: Merri Creek–Summerhill Road

Map reference. 7822 202395. **Altitude.** 200 m. **Survey date.** 1 February 1989

Vegetation. Instream: submerged and emergent herbfield (good condition; 30% cover of algae). Bank: Woolly Tea-tree riparian scrub (18.2; good condition). Frontage: Lightwood–Tree Violet cliff/escarpment shrubland (20.5; fair condition with Kangaroo Grass and Red-leg Grass but advancing alien shrubs and herbs including Yorkshire Fog, Spanish Artichoke, Spear Thistle and Chilean Needle-grass)

Physical Features:

Pools

Substrate. Deep silt and basalt boulders on basalt base

Maximum size (mid-summer). 10 m wide by 3 m deep by 100 m long

Riffles

Substrate. Basalt boulders and cobbles on basalt base and sections of tessellated pavement

Flow (mid-summer low): Size. 1.0 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 4.8 ML/day

Water quality

Summer: Temperature. 21.0°C. **Conductivity.** 1600 ms. **Turbidity.** Cloudy water in the pools caused by algae

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (1); migratory sub-adult. Flat-headed Gudgeon (1); likely breeding resident

Alien species numbers/status. Mosquito Fish (20 electrofished and an additional 100 seen); likely breeding resident

Other comments. Freshwater Blackfish have been caught in this location in recent years (Evelyn Draper pers. comm.). Land tenure: private farmland. Mosquito Fish pose a threat to native fish by predation of eggs and fry and competition for food and space.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. There is an intact riparian habitat link downstream to the Craigieburn Grassland site, an intact overland link to the Summerhill Road site and a partially fragmented link upstream to the Kalkallo–Donnybrook North Rail Reserve site and the Bald Hill site.</p> <p>Strategic Habitat Link. The site forms the most intact and important grassland/riparian habitat link between the Craigieburn Grassland, Summerhill Road and Bald Hill sites. These are each of State to National faunal significance. Protection and enhancement of habitat links between these three sites is a principal recommendation of the Regional Habitat Link Strategy. The site is accordingly nominated as a Strategic Habitat Link in NEM. Protection of native vegetation and conservation management of the habitat link is critical for long-term conservation of fauna at Craigieburn Grassland. Possible impact on the effectiveness of the Strategic Habitat Link must be addressed during planning considerations for future urban growth.</p>	
<p>Habitat link fragmentation: urban encroachment and farmlet subdivision. The site lies close to advancing commercial/industrial development from the south. Broad-acre farmland between the creek and the Hume Freeway to the south of Donnybrook Road has been recently subdivided into small farmlets and extensively rock-cleared.</p>	<p>Strengthen habitat link and upgrade streamway conservation management. The significant riparian scrub and escarpment shrubland and grassland along Merri Creek and its frontage needs to be protected and placed under conservation management. Regeneration of this vegetation is urgently required and should be developed through incentives such as rate concessions and advice/assistance for landowners who implement native habitat conservation management programs. This will raise long-term conservation values and enhance the sustainability of the surrounding land for farming by reducing land degradation factors such as salting.</p> <p>Fencing the steep-sided creek gorge has protected the stream from livestock grazing. Land protection work is needed (weed, fox and rabbit control). A wider grazing set-back of 50 m or more from the top of the escarpment would enable regeneration and replanting of River Red Gums, escarpment shrubland and frontage grassland. This would provide an effective habitat link.</p> <p>Protection of native grassland and rocks. The present rate of rock removal (primarily used for landscaping) outside quarry permit areas should be regulated. Specific conservation management guidelines to protect threatened plains grassland habitats, rock outcrops and species such as the Striped Legless Lizard are required for the site.</p>

Foxes and dogs. Foxes prey on livestock and wildlife and there has been a considerable increase in numbers along Merri Creek since the survey commenced in 1986. Roaming dogs are also in nuisance numbers and feral cats have been seen in the cliffs along the creek.

Fox fence—Save the Bush grant. A grant application to the Save the Bush fund to erect a fox and dog proof fence along one side of the creek, covering several properties, has been approved (Nick van Roosendael pers. comm.). Fox shooting is commonly employed but is inefficient and not effective. Poisoning is conducted, but also affects other wildlife.

Regional Hydrological Strategy

Declining water quality and faunal disturbance along creek. Urban growth development, which may occur between the creek and the Hume Freeway, would reduce the biological values of the Merri Creek. Water and riparian vegetation quality would be reduced by further treated sewage and stormwater outfall. This would threaten the small populations of Freshwater Blackfish, Lewin's Rail and Platypus present. The increased level of disturbance arising from development would likely result in the abandoning by the Wedge-tailed Eagles of the nest-site along the creek.

Declining water quality and depletion of riparian vegetation are major causes of the rarity of the Platypus in Merri Creek. Increased levels of water pollution has depleted prey species. Invertebrate and water quality studies determined this section of Merri Creek to be in decline as it contains low oxygen and high levels of pesticides, herbicides and fertilisers (Campbell *et al.* 1982). Native freshwater crustaceans (e.g. *Engaeus quadrimanus* and *Paratya australiensis*) in Merri Creek are an important food source for the Platypus. These invertebrates are dependent on low water pollution and turbidity conditions and adequate native instream and riparian habitat.

Monitor/improve water flow and quality of Merri Creek. A full water quality assessment of the creek needs to be conducted. Any new development such as regional sewage treatment plants and infill tips which compromise these values require full environmental impact assessments.

Conservation management of streams, such as Merri Creek, in farm catchments needs to be improved. Management of riparian waterbirds such as the Lewin's Rail should be directed towards careful replacement of Blackberries and other riparian weeds with indigenous species and protecting streams from human disturbance and livestock trampling. Broad-scale herbicide spraying causes stream bank slumping and water turbidity. The effects of pesticide residues on aquatic invertebrate prey species are largely unknown.

Habitat dependent and ecologically specialised species such as the Lewin's Rail and Platypus illustrate the complexity and interdependence of native ecosystems. Monitoring populations of these depleted species, their ecological requirements and threatening processes such as declining water quality, will assist in formulating conservation management guidelines which may prevent broad-scale extinctions.

Electrofishing site: There was some bank erosion–slumping of upper escarpments from livestock grazing. The water temperature was relatively high and algal blooms were present. The water is apparently nutrient enriched from upstream sources such as the Wallan sewage treatment plant and runoff from paddock livestock faeces. Additional sewage plants along the Merri could trigger severe algal blooms and water eutrophication, toxification and de-oxygenation problems during low flow periods. The water conductivity level in the Merri Creek was about five times higher than that recorded for the corresponding section of the Plenty River. The summer–autumn water salinity levels of the smaller pools may be of the order of 3 parts per thousand (i.e. saline) and salinity tests must be conducted. Salt indicator plants occur along the creek (e.g. Creeping Brookweed, Australian Salt-grass and Sharp Rush). The death of the River Red Gums would, in part, be attributable to salting.

Impact from the Craigieburn Clay quarries on Merri Creek. The quarry south of Summerhill Road is located close to Merri Creek. This section was likely to have contained the Striped Legless Lizard. As well as direct loss of escarpment vegetation and weed invasion, earthworks along the face of the quarry have caused rock and soil debris to tumble down the eastern escarpment. This (particularly the weed invasion) has affected flora and faunal habitat values along the creek as there was an inadequate habitat buffer. The quarry is likely to have had an impact on local stream and groundwater flows.

Stream salination and weeds/vermin along creek and in grasslands. Stream salination is evident in the site. Sharp Rush occurs along Merri Creek, probably promoted by salinity. There is inadequate regeneration of riparian and escarpment vegetation. Foxes and rabbits are abundant along the creek.

Extractive industry licence conditions required where these affect significant creek habitat.

There should be more stringent controls regarding the environmental impact of quarries close to Merri Creek.

Require streamway land-use & conservation plan including the address of salination.

The streamway is the integral section of the site as a Strategic Habitat Link. Effective and integrated conservation management of the streamway would protect biological values within the stream. The creek contains significant instream vertebrates and invertebrates (see Campbell *et al.* 1982). For these species to persist, the streamway frontages must be fenced and revegetated and the water quality must be improved.

Water quality studies, including seasonal monitoring of salinity, nitrate and *E. coli*, need to be conducted. While still dominated by native plants, the advancing weeds need controlling. The summer stream flow increases markedly from upstream of Donnybrook to Summer Hill Road with no appreciable surface input. It is likely that the section downstream of Donnybrook is fed from underground aquifers and springs. This may be a source of saline water linked to loss of native vegetation, death of the Swamp Gums and poor land management practices such as over-grazing in recharge areas toward Woody Hill.

Require adequate buffer areas along the west side of Merri Creek from future urban development.

Other Issues

North Eastern Railway—reserve grading/slashing. V Line put in an access track through the grassland along the rail reserve in 1987. Most of the orchid species were eliminated.

Biological surveys. Surveys to determine the extent of the vulnerable Striped Legless Lizard population should be conducted. Botanical surveys are also required.

Implementation of Native Vegetation

Clearance Controls on private land. These should protect native rock and native grassland.

Land protection works/weed control along Merri Creek. Invasive noxious weeds such as Chilean Needle-grass, Gorse, Sharp Rush, Serrated Tussock and Spanish Artichoke should be removed from along the creek. Gorse can be effectively and safely controlled with Garlon. While prolific, it is not the first weed that should be dealt with. It actually provides important cover and feeding habitat for White-fronted Chats, Yellow-rumped Thornbills, Diamond Firetail and Red-browed Finch, White-browed Scrubwrens, Flame Robins, Superb Fairy-wrens and many other small passerine birds. It should not be removed before structurally similar replacement species such as the Tree Bursaria, Golden Wattle and Tree Violet have established. These species cannot establish or persist while the area is being grazed by livestock.

Malcolm Creek riparian link/public interpretation. The riparian link along Malcolm Creek should be placed under conservation management. This creek links the site to the Mickleham–Mount Ridley site of significance in Western Melbourne (Beardsell in prep.). Discontinuous bands of River Red Gums and sections of reasonably intact rocky grassland and herbfield are present along the creek. Fencing from livestock to facilitate natural regeneration and extensive replanting in alienated sections is required. Incremental growth from Craigieburn may, in time, envelop the creek. In this event, the creek should be reserved as public open space and the natural values be conserved. It lends itself to the establishment of a nature trail and could thus serve to educate the public on aspects of nature conservation.

Conservation incentives to landowners.

Site 12 O'Herns Road Wetlands

Map Reference:	7822 205327 (O'Herns Road Quarry and O'Herns Road Swamp). One minute lat/long grids include 37° 38' x 144° 58'.
Location/Size:	Approximately 70 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: nil. Private: zoned rural (broad-acre farm settlement with sheep and cattle grazing). Land to the south proposed for a motorbike dragstrip.
Landforms:	Volcanic plain (see MLVP C). Elevation is 140–150 m.

Natural Heritage Values

Landscape. The O'Herns Road Wetlands provide the most extensive and intact permanent open wetland and shallow freshwater marsh combination on the volcanic plains of NEM. Along with the Craigieburn Grassland it forms the proposed Volcanic Plains Ecological Reference Area in NEM.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Relatively intact and extensive stands: Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2; O'Herns Road Swamp); Blunt Pondweed permanent wetland (26.1; O'Herns Road Quarry)

Partially intact or small stands: Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7)

Remnant, degraded or establishing stands: River Red Gum grassy woodland (14.1; grazing land); Kangaroo Grass plains grassland (23.2; grazing land); Brown-back Wallaby-grass seasonal wetland (25.3; grazing land)

Rare species: River Swamp Wallaby-grass, *Amphibromus* sp. aff. *nervosus*, Water Starwort (*Callitriche umbonata*)

Critical assemblages or populations: Volcanic Plains Ecological Reference Area

Notable features: O'Herns Road Quarry is the most significant artificial waterbody for waterbirds on the volcanic plains of NEM. It supports extensive submerged herbfields dominated by Fennel Pondweed.

FAUNAL SIGNIFICANCE: Site 12 O'Herns Road Wetlands

Assessment: State—Category 3 (C, D); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

12^a: 37° 38' x 144° 58'; O'Herns Road Wetlands

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 12^a: Freckled Duck, Blue-billed Duck and Black Falcon

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

State. 12^a: 30 species in a 60-minute census at O'Herns Road Wetlands on 21 August 1991

Regional. 12^a: 22 species in a 60-minute census at O'Herns Road Wetlands on 4 October 1991

d. Breeding waterfowl

Regional. 12^a: 7 species including the Hoary-headed Grebe, Chestnut Teal, Hardhead and Australasian Shoveler at O'Herns Road Quarry on 4 October 1991

k. Frogs

Local. 12^a: 5 species at O'Herns Road Wetlands on 4 October 1991

I. Reptiles

Regional. 12^a: 6 species including the Bougainville's Skink, Tussock Skink, Little Whip Snake and Tiger Snake at O'Herns Road Wetlands on 4 October 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 12^a: over 70 species

d. Herpetofauna

Regional. 12^a: 11 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 12^a: 22 species

b. Regionally endangered fauna (R1 species)

Regional. 12^a: 2 species. **Birds:** Little Button Quail; Freckled Duck

c. Regionally vulnerable fauna (R2 species)

State. 12^a: 6 species. **Birds:** Whiskered Tern, Black-winged Stilt, Spotted Harrier, Black Kite, Black Falcon, Blue-winged Parrot

d. Regionally rare fauna (R3 species)

State. 12^a: 8 species. **Birds:** Australian Crake, Great Crested Grebe, Red-kneed Dotterel, Blue-billed Duck, Hardhead, Pink-eared Duck, Australasian Shoveler, Musk Duck

e. Regionally depleted fauna (R4 species)

Regional. 12^a: 6 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Swamp Harrier, Peregrine Falcon, Striated Fieldwren

f. Regionally restricted fauna (R5 species)

Regional. 12^a: 12 species. **Birds:** Banded Lapwing, Royal Spoonbill, Great Egret, Cattle Egret, Australian Shelduck, Barn Owl, Long-billed Corella, Brown Songlark, Singing Bushlark. **Reptiles:** Bougainville's Skink, Tussock Skink, Little Whip Snake

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 12^a: 14 Latham's Snipe at O'Herns Road Swamp on 4 October 1991

b. Rare or threatened fauna

Regional. 12^a: 6 Blue-billed Ducks at O'Herns Road Quarry on 21 August 1991 and five on 4 October 1991

c. Waterfowl

Regional. 12^a: 223 individuals of 15 species at O'Herns Road Quarry on 21 August 1991 and 174 individuals of 10 species on 4 October 1991

f. Frogs

Regional. 12^a: over 300 Growling Grass Frogs at O'Herns Road Quarry on 4 October 1991

g. Rare/restricted colonial fauna

Regional. 12^a: 300 Australian White Ibis, 200 Straw-necked Ibis and 50 Cattle Egrets at O'Herns Road Wetlands and inundated paddocks and the City of Whittlesea tip to the south-east on 21 August 1991

l. Regionally vulnerable fauna (R2 species)

Regional. 12^a: 10 Whiskered Terns at O'Herns Road Wetlands on 4 October 1991; 8 Black-winged Stilts including a nesting pair at O'Herns Road Swamp on 4 October 1991 and 6 (two nesting pairs) on 17 January 1997; 10 Blue-winged Parrots at O'Herns Road Swamp on 5 June 1991

o. Regionally restricted fauna (R5 species)

Regional. 12^a: 10 Banded Lapwings south-east of O'Herns Road Wetlands on 5 June 1991; 50 Australian Shelduck at O'Herns Road Wetlands and inundated paddocks to the south-east on 21 August 1991

Outlook

Sixteen of the nineteen sub-criteria the site meets for Regional significance are essentially for waterbirds. Further survey is likely to provide additional critical species including the Australasian Bittern (swamp). The faunal significance would increase to State on several other sub-criteria under the management proposed in the conservation measures.

FAUNA

Rare or Threatened Fauna

Bc 12^a: Freckled Duck at O'Herns Road Quarry. Two were present on the wetland on 4 October 1991. The quarry contains sections of deep open water, fringing Common Reed–Cumbungi emergent herbfield (25.7) and shallows with submerged herbfields of Blunt Pondweed–Fennel Pondweed permanent wetland (26.1). The Freckled Duck was recorded elsewhere only from a farm lake on 'Silver Gum Park' near Woodstock (site 17) and Morang Wetlands in Plenty Gorge Park (site 40). Both were single birds. The former was with 100 other ducks in 'hunter-refuge' after duck opening, March 1988. The lake at Woodstock contains permanent water, beds of Cumbungi near an island and extensive shallows and rocky shorelines amongst River Red Gum grassy woodland (14.1). Stragglers probably irregularly visit other larger waterbodies in NEM containing deep, open water and shallows with submerged meadows (e.g. Yan Yean Reservoir).

The stronghold of the Freckled Duck is the river systems of inland eastern Australia. They are an infrequent and rare spring–autumn visitor to GM. Peaks in Victoria coincide with inland drought years, following a sequence of wet, productive years. The drought in western NSW is likely to have influenced the presence of the pair seen at O'Herns Road Quarry on 4 October 1991. Small numbers of juveniles and non-breeding adults disperse from drying inland wetlands into Victoria at other times (Emison *et al.* 1987).

Nesting has not been recorded for three decades in Victoria (Emison *et al.* 1987). In western NSW they build a nest-platform in low shrubs (e.g. Tangled Lignum) amongst floodwaters. During the day, birds rest on the deep, open water, moving at night to the shallows to feed (Readers Digest 1986). Freckled Duck take tiny fish, crustaceans and other invertebrates. These include insect larvae (e.g. midges) and gastropod molluscs from dabbling the substrate of shallows, zooplankton from open water, algae scraped from shallow, submerged logs and seeds from pondweeds, sedges and water-grasses (Readers Digest 1986).

Freckled Duck are one of the world's rarest waterfowl. National population estimates during the drought of 1983 ranged between 8000 and 20 000 birds (Blakers *et al.* 1984, Emison *et al.* 1987). Clearing, grazing and draining of wetland breeding areas in western New South Wales has reduced the population. Deep, open water with fringing and submerged vegetation is required. The Freckled Duck is rare throughout GM, but is most common and frequently seen at the Werribee Sewage Farm in WM (Lane *et al.* 1984, Schulz *et al.* 1991). In early 1980, 235 were counted on Lake Borrie and the following year, during a statewide duck opening count in March, the wetlands on the farm contained over 5% of the Victorian population (an estimated 3000 in the state in 1981). That year, despite being protected, about 800 birds were shot in Victoria during duck opening.

Bc 12^a: Blue-billed Duck at O'Herns Road Quarry. Six were observed on 21 August 1991 while five were present on 4 October 1991 in the open water areas 2–3 m deep. They dabble, upend and dive for invertebrates and fruit and foliage of Fennel Pondweed which dominates the submerged herbfield (26.1).

Bc 12^a: Black Falcon—irruption of inland birds of prey in autumn–winter 1991. One was observed over the swamp (25.2/26.1) on 21 August 1991 (see site 13).

Critical Assemblages or Populations

Cb 12^a: High diversity of waterbirds—O'Herns Road Wetlands census, August and October 1991. The wetlands consist of O'Herns Road Quarry and the adjoining O'Herns Road Swamp. Thirty waterbird

species were recorded in a sixty minute census on 21 August 1991. 223 individuals of 15 species of waterfowl were present at the quarry. Notable waterbirds at both wetlands included the Australian Spotted Crake (2), Great Crested Grebe (4), Latham's Snipe (2), Royal Spoonbill (1), Great Egret (1), Cattle Egret (20), Australian Shelduck (20), Chestnut Teal (40), Pink-eared Duck (2), Hardhead (30), Blue-billed Duck (6), Australasian Shoveler (1), Pink-eared Duck (2) and Musk Duck (4).

Twenty-two waterbird species were recorded at O'Herns Road Wetlands in a 60-minute census on 4 October 1991. 174 individuals of 10 species of waterfowl were present at the quarry. Notable waterbirds at both wetlands included the Brown Quail (1), Buff-banded Rail (1), Purple Swamphen (2), Eurasian Coot (30), Hoary-headed Grebe (40), Whiskered Tern (10), Latham's Snipe (14), Red-kneed Dotterel (1 pair; breeding), Black-fronted Plover (1 pair), Black-winged Stilt (7; breeding), Great Egret (1), Australasian Shoveler (3), Freckled Duck (2), Hardhead (42), Blue-billed Duck (5) and Swamp Harrier (1). Seven species of waterfowl were breeding at the quarry. These included the Hoary-headed Grebe, Eurasian Coot, Australasian Grebe, Pacific Black Duck, Chestnut Teal, Hardhead and Australasian Shoveler. The Australian Shelduck was recorded breeding in grassy seasonal wetland (25.2) at O'Herns Road Swamp on 8 November 1996 (Mark Tscharke pers. comm.).

The wetlands provide an ideal habitat combination. Submerged herbfield (26.1) occupies the open water/deep freshwater marsh sections and emergent herbfield (25.7) fringes the shallow freshwater marsh sections of the quarry. These are important for waterfowl and large shorebirds and waders (e.g. stilts and spoonbills). Grassy seasonal wetland (25.2) of the swamp freshwater meadows is important for cover-dependent waders (particularly stilt and snipe) and large shorebirds (herons). The open water in the quarry is mostly 2–3 m deep. Along with the shallows, this supports an extensive stand of Fennel Pondweed and high diversity and population density of waterfowl, particularly grebe, teal and Hardhead. Australian Shelduck range into seasonally inundated grassy meadows of the district during winter. The quarry has emergent rocks which provide bird roosts and productive mudflat shallows for small shorebirds (e.g. dotterels).

O'Herns Road Quarry is the most important wetland for waterfowl on the western volcanic plains of NEM. Sixteen species have been recorded. Waterfowl populations build to over 300 birds between late summer and late winter. Neighbouring quarries have been infilled by tips. O'Herns Road Quarry is the last still containing a large and permanent body of freshwater. It is integral to the populations and local and seasonal movements of waterfowl and other waterbirds on the volcanic plains of NEM. O'Herns Road Wetlands and the adjoining Craigieburn Grassland together form the most intact and diverse grassland/wetland system in NEM.

Other Significant Fauna

Birds

Eb 12^a: Little Button-quail. Two sightings were made in NEM in June 1991 during a local irruption from the inland. One of these was at Bald Hill (site 4) and the other was two birds in Common Tussock-grass plains grassland (23.1) at O'Herns Road Swamp on 5 June 1991. They had previously been observed south-west of Wollert in 1986 and in the Diamond Creek headwaters in autumn 1988. Prior to the 1986–1996 survey, there had been no published sightings of the species in GM (e.g. Emison *et al.* 1987). The distribution of this button-quail is centred on the arid (Eyrean) rainfall zone of central Australia.

Little Button-quail are seldom reported due to their small size, cryptic behaviour and occupation of remote grassland habitat in broad-acre farmland. Being largely solitary and non-breeding in southern Australia, they are found only in small numbers. Their grassland habitat is usually smaller than that required by the Red-chested Button-quail. In NEM, these occur largely in low-lying freshwater meadows on the gilgai plains (black cracking uniform soils).

Little Button-quail are nomadic and irruptive in movement, determined by inland Australian weather patterns (Blakers *et al.* 1984, Readers Digest 1986). During inland droughts (e.g. 1990/91), they extend their range into the grasslands and shrublands of southern Australia. The autumn of 1991, when birds arrived in the Merri Volcanic Plains, had been very dry locally. They remained over winter and vacated by spring, after heavy winter rains. A summer–autumn dispersal of juveniles into the southern portion of their range to utilise seeding grasses

or cereal crops may occur at more frequent intervals (Blakers *et al.* 1984, Readers Digest 1986). Interruptions occur in drying years after productive breeding seasons (floods) in the inland (e.g. 1970–72 and 1977–79).

Breeding has not been recorded in GM, but may occur during inland irruption years. In inland areas they breed opportunistically at any time of year after rains producing a flush of herb growth and seed production of native grasses and grassland herbs (Readers Digest 1986). Nest construction and breeding behaviour is similar to that of the other button-quails. The nest is a shallow ground-scraps lined with dry grass.

Ec **12^a: Black-winged Stilt.** A pair had begun building a nest of dry herbage amongst low, emergent vegetation in Common Tussock-grass–Rush Sedge seasonal wetland (25.2) in shallow water at the southern end of O’Herns Road Swamp on 4 October 1991. Another six were wading in the mudflat shallows of the adjacent O’Hern’s Road Quarry. They were picking invertebrates from the water surface and probing for them in the muddy substrate. Two pair bred in spring–summer 1996, each successfully rearing one young. This is only the second breeding locality of the species in NEM (see site 40). Six birds were observed feeding in the shallows at the southern end of the swamp on 17 January 1997. A pair of Purple Swamphen with nest and young was present in the central Cumbungi emergent herbfield (26.1) of the swamp in January 1997.

Ec **12^a: Spotted Harrier and Black Kite—irruption of inland birds of prey in autumn–winter 1991.** A Black Kite and three Spotted Harriers were seen over the swamp and surrounding plains grassland (23.1/23.2) of O’Herns Road Wetlands on 5 June 1991. The area had received little effective rainfall for six months. The drought in western New South Wales is likely to have influenced both bird species to move toward the southern coast. The Spotted Harriers were in poor condition. Rabbits, their usual prey, were locally scarce and they were forced to hunt for House Mice and frogs. Hares were possibly being taken.

The Black Kite is primarily a carrion (animal carcass) feeder and was seen at the nearby City of Whittlesea tip where it was scavenging for food-scrap amongst a flock of 1000 Silver Gulls and 300 Australian White Ibis. Black Kites visit the western volcanic plains of GM from late summer to late winter, about every two years in three, predominantly as single birds. Small irruptions occur in dry years after inland floods (e.g. 1978–80) and during mouse plagues (1988). At these times, over-wintering birds breed in early spring. A couple of birds appeared immediately after a bushfire in the Plenty Gorge near South Morang at the end of February 1980. Attracted by smoke, they arrive near Rockbank in WM around Labour Day at the start of stubble burn-offs.

Ec **12^a: Blue-winged Parrot and other grassland birds of the freshwater meadows in autumn–winter 1991.** Late summer–autumn 1991 received well below average rainfall. Ten Blue-winged Parrots were observed on the dry mudflats (25.2) of O’Herns Road Swamp on 5 June 1991. They were feeding on fallen seeds of thistles and swamp plants. They disperse over the plains during autumn from coastal breeding grounds. Ten Banded Lapwings were observed in the paddocks south-east of the wetland on 5 June 1991. This species extends into local grazing land from further west on the volcanic plains during autumn–winter. Small numbers of spring–summer migratory grassland passerines including the Brown Songlark and Singing Bushlark had remained as a result of the dry conditions.

The following winter months each received well above average rainfall and the swamp and grassy meadow swales and gilgais were inundated. Over 500 Australian White and Straw-necked Ibis, Cattle Egrets, White-faced and Pacific Herons, Yellow-billed Spoonbills and Australian Shelducks were present. These temporary wetlands have a significant role in providing feeding habitat during the seasonal movements of waterbirds in NEM (see also Hernes Swamp, site 2). At dusk, the birds roost at O’Herns Road Quarry or fly westward, possibly to Greenvale Reservoir.

Ed **12^a: Australian Spotted Crake and Red-kneed Dotterel at O’Herns Road Quarry.** Two Australian Spotted Crakes were present in the Cumbungi (25.7) along the eastern edge of the wetland on 21 August 1991. A pair of Red-kneed Dotterel was nesting at the southern shoreline on 4 October 1991. The drought in western NSW may have contributed to the presence of the dotterels. In 1991 there was a local influx of this species and the Little Button-quail, Spotted Harrier and Black Kite onto the volcanic plains.

Ed **12^a: Regionally rare waterfowl at O’Herns Road Quarry.** The Great Crested Grebe, Blue-billed Duck, Pink-eared Duck, Hardhead, Australasian Shoveler and Musk Duck were recorded on 21 August 1991 (see *Cb*).

Ee **12^a: Brown Quail, Buff-banded Rail and Latham's Snipe.** Each present in Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2) at O'Herns Road Swamp on 4 October 1991. The quail was also heard calling from the swamp on 22 December 1995 (Paul Peake pers. comm.; Ecology Australia 1996). Fourteen snipe were flushed on 4 October 1991. This is the largest number recorded on the volcanic plains of NEM during the fauna study. O'Herns Road Swamp qualifies as significant migratory bird habitat requiring protection under international agreement. Two early arrival snipe had been recorded at the swamp on 21 August 1991. Numbers build through spring and remain until mid-summer in wet years.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Intact habitat links to Craigieburn Grassland site and Edgars Creek Headwaters site.</p>	
<p>Establishment of a Volcanic Plains Ecological Reference Area (ERA). See Appendix 2.1</p>	
	<p>Merri Creek Conservation Area—incorporation of the O’Herns Road Wetlands. The quarry and swamp should be included in the Merri Creek Grasslands Park. These wetlands add a great deal of natural diversity to Craigieburn Grassland, making a very rich grassland/wetland ecosystem for wildlife. Few of the remaining waterbodies in the western section of NEM contain significant populations of waterfowl. O’Herns Road Quarry contains permanent deep open water, rock islands and submerged and emergent herbfields. It supports large populations of waterfowl and other waterbirds. Smaller but significant populations of waders (e.g. snipe, herons, spoonbills and Black-winged Stilts) occur at the swamp. Both wetlands should be managed for conservation purposes.</p>
Regional Hydrological Strategy	
<p>Damage to swamp meadows by stock grazing/trampling. The freshwater meadows surrounding O’Herns Road Swamp have been damaged by cattle grazing. In 1991, fences had been cut between the quarry and the swamp to allow the entry of cattle. Heavy grazing over winter in 1991 caused severe pugging of the grey-black soil, weed invasion and loss of tall native grass cover. This is the habitat of cover-dependent birds such as the Brown Quail, Buff-banded Rail, Black-winged Stilt, Latham’s Snipe and Striated Fieldwren.</p> <p>The damage being caused by the current (and recent past) level of grazing is degrading the floral and faunal values of the swamp. Livestock grazing has in particular, damaged the meadows at the swamp where the snipe feed and led to the advance of Chilean Needle-grass.</p>	<p>Cessation of livestock grazing at O’Herns Road Swamp. All livestock grazing should be discontinued.</p> <p>Seasonal closure of the wetlands. Human visitation or disturbance to the wetlands during the breeding season (late August to late December) leads to waterbird breeding failure. The wetlands should be accordingly closed to all human visitation over this period. Increased disturbance levels may result in the loss of the snipe (and other significant species such as Black-winged Stilts) from the swamp. Disturbance at other times of the year should be carefully planned and regulated (e.g. minimal at the quarry in late summer/autumn when large numbers of waterfowl congregate).</p> <p>Require land-use and conservation plan for the site.</p>

Other Issues

Potential use of O'Herns Road Quarry as a tip. Most of the bluestone quarry in the Cooper Street area formerly provided significant habitat for waterfowl. Most have been infilled for tips. The use of O'Herns Road Quarry for a tip would eliminate a significant site for waterbirds and the potential for enhancement of wetland values in the biogeographical zone.

Weed invasion of the quarry cliffs and swamp meadows. The cliffs are infested with Gorse, Spanish Artichoke, Bathurst Burr, Serrated Tussock and Spear Thistle. Areas of Montpellier Broom, Toowoomba Canary-grass and Chilean Needle-grass fringe the swamp.

Grazing of the reserve along O'Herns Road. Sections of O'Herns Road have been wired off and grazing has been allowed. The road reserve contains remnant shrubland (Tree Violet and Hedge Wattle) on the stony knolls and sections of important plains grassland. These have been eaten down and the soft meadows have been pugged. A number of grassland passerines utilise the shrubs (e.g. White-fronted Chat for nesting and Flame Robin for cover).

Fox and rabbit populations. In favourable seasons high densities of foxes and rabbits occur in the rubble and gorse at O'Herns Road Quarry.

O'Herns Road Quarry should not be used for a tip. Any proposal for use as a tip should be opposed on the grounds that the quarry contains highly significant flora and faunal values. **Rehabilitation of O'Herns Road Quarry.** With rehabilitation works the quarry has the potential to become one of the most important waterbird areas near Melbourne. Works should include planting River Red Gums near the water's edge, planting wattles and other volcanic plains shrubs on the escarpments and cliffs, placing logs in the shallows and stocking native fish to provide additional habitat for waterbirds. Weed control along the cliffs of the quarry should be accompanied by extensive shrub planting. Suitable species include Lightwood, Black Wattle, Blackwood, Drooping Sheoke and Tree Bursaria. Tree Banksia, which formerly grew on the stony knolls, should also be grown and planted. This species has been eliminated from the Merri Plains and is very scarce throughout the Western Volcanic Plains.

Public interpretation. The wetlands offer great potential for waterbird observation and research. The entire wetland can be viewed from several vantage points. The diversity of birdlife on the O'Herns Road Wetlands, particularly waterfowl and waders, offers high potential for public appreciation and awareness of wetland fauna and their conservation. Visitor use would have to be controlled. The cliffs are steep and dangerous and the public should not be allowed to gain access to these areas. Human activity disturbs the waterbirds so screen and shelter plantings will need to be provided near these vantages before the wetland could be made available for viewing. The establishment of bird hides would be desirable. Apart from suburban lakes (e.g. Edwardes Lake Park) the Merri Plains is virtually devoid of wetlands. With revegetation works there is scope for the wetland to become an important waterbird interpretation area.

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on rock removal, land clearing, cultivation and excessive grazing of significant wetland and grassland habitat.

MLVP D WOLLERT-EDGARS CREEK HEADWATERS

This management unit consists of two sites of state faunal significance (sites 13 and 14) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7822 220340 (mid-point of 'Hendon Park'); 7822 233357 ('Storncroft'); 7822 225391 (Gas and Fuel Swamp); 7822 226410 (Woody Hill Swamp); 7822 233401 ('Boonderoo' woodlands).

Location/Size: Headwaters of the Edgars Creek and Summer Hill drainage line which rises south of Woody Hill and flows into the Merri Creek south of O'Herns Road between the Merri Creek and Epping Road and O'Herns Road and Donnybrook Road. Approximately 4300 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands. It is on a local watershed divide between Darebin Creek and Merri Creek and is the only one on the plains of NEM not associated with a major stream. The surface topography is flat and watercourses contain ill-defined floodplains. The unit contains broad areas of volcanic plains grassland and grassy woodland. Along with the Craigieburn unit, the area receives the lowest rainfall in NEM and consequently has stronger affinity with the low rainfall Keilor/Werribee Plains of WM. The Edgars Creek contains extensive 'black soil' gilgai plains.

Landforms

Foothill: hill-crest and hill-slopes (Woody Hill). Volcanic plain: stony crests, stony rises, buckshot crests, stony plains, gilgai plains, ephemeral rocky drainage lines and floodplains, swamps and swales. Elevation is 140–240 m.

Hydrology

There is little surface relief in the headwaters of Edgars Creek and extensive sections of low-lying marshland with heavy black soil and high water table are present. Runoff occurs after heavy rains. The Pakenham Blue Metal and Gas and Fuel land at Summerhill Road contains the headwaters of the ephemeral Summer Hill drainage line. This flows southwards, crossing Craigieburn Road East and Craigieburn Grassland to join Merri Creek south of O'Herns Road. There are two freshwater meadows: Gas and Fuel Swamp of approximately 5 ha and Woody Hill Swamp of approximately 8 ha. Both occur on flat, low-lying terrain at the top of a local divide separating the catchments of Darebin Creek and Merri Creek. Woody Hill Swamp, which lies to the south-east of Woody Hill, may connect Merri Creek through underground springs. Both swamps appear to have been formed when lava flows interrupted the headwaters of the Summer Hill drainage line. Due to local topography the water table is high and there are indications of dryland salination.

The basalt and scoria of the Quaternary Volcanics rest on marine Tertiary alluvium and Silurian sandstone beds, normally at a depth of less than 40 m. The volcanics are closely jointed and have a high vertical water porosity and horizontal permeability. This and low surface relief mean that agriculture in the Summerhill Road site is dependent on bore water. Aquifers develop along old ground surface drainage lines under the basalt. These percolate from springs and directly feed the creeks. The old ground surface drainage lines form sumps for groundwater intake. The rate of flow of the aquifers is dependent on the groundwater intake. Groundwater intake, movement and discharge is poorly researched. The underground water in the Merri Plains contains high components of dissolved solids. It is generally unsuitable for domestic use apart from garden watering and drinking water for sheep and cattle. Contamination of groundwater is likely to occur from quarry tips (e.g. Cooper Street).

Rainfall: 600–630 mm.

Site 13 Edgars Creek Headwaters

- Map Reference:** 7822 220340 (mid-point of ‘Hendon Park’); 7822 233357 (‘Storncroft’). One minute lat/long grids include 37° 36' x 144° 59', 37° 37' x 144° 58' to 145° 00' and 37° 38' x 144° 59' to 145° 00'.
- Location/Size:** Occurring between Cooper Street, Epping Road and Boundary Road. Approximately 1900 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: nil, apart from road reserves along Vearings Road and O’Herns Road. Private: zoned general farming. Mostly broad-acre sheep and cattle farming; some small farmlets along Craigieburn Road.
- Landforms:** Volcanic plain (see MLVP D). Elevation is 130–200 m.

Natural Heritage Values

Landscape. The site supports extensive areas of volcanic plains landforms including stony rises and crests, stony plains, gilgai plains and ephemeral creek valley/floodplains. These support broad sections of relatively unmodified grassland and grassy woodland which are fine illustrations of the natural character of the landscape.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Relatively intact and extensive stands: River Red Gum (volcanic plain) grassy woodland (14.1)

Partially intact or small stands: River Red Gum (plains) drainage line woodland (30.1; headwaters of Edgars Creek at Vearings Road/Hendon Park); Kangaroo Grass stony knoll grassland (22.1); Common Tussock-grass plains grassland (23.1); Kangaroo Grass plains grassland (23.2; grazing land); Common Spike-sedge drainage line herbfield (24.1; Edgars Creek); Brown-back Wallaby-grass seasonal wetland (25.3)

Endangered, vulnerable or rare species: unsurveyed; potential for Tough Scurf-pea and Curly Sedge along terraces of the Edgars Creek (which would upgrade conservation status to very high) and regionally threatened stony knoll species recorded from Craigieburn Grassland

Critical assemblages or populations: Strategic Habitat Link, critical in maintaining the population viability of grassland fauna at Craigieburn Grassland. Extensive stand of grassy woodland at Hendon Park and properties fronting Harvest Home Road and relatively intact stony knoll grassland along closed sections of Vearings Road and O’Herns Road

Notable features: remnant grassland on ‘paddock’ stony knolls at Hendon Park and properties fronting Harvest Home Road.

FAUNAL SIGNIFICANCE: Site 13 Edgars Creek Headwaters

Assessment: State—Category 2 (B, C, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

13^a: 37° 36' x 144° 59'; Storncroft/Craigieburn Road East

13^b: 37° 37' x 144° 59'; upper Edgars Creek/Hendon Park

13^c: 37° 37' x 145° 00'; Harvest Home Road Wollert

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 13^a: Regent Honeyeater

b. Vulnerable fauna

State. 13^b: Striped Legless Lizard

Unranked. 13^b: Southern Stone-curlew at Hendon Park until about 1940

c. Rare fauna

Regional. 13^a: Grey Goshawk, Black Falcon, Barking Owl

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

g. Breeding parrots

Regional. 13^a: 6 species including the Purple-crowned Lorikeet and Long-billed Corella at the corner of Craigieburn Road East and Vearings Road on 8 December 1991

h. Bats

Regional. 13^a: 5 species including the Southern Freetail Bat at the corner of Craigieburn Road East and Vearings Road on 8 December 1991

k. Frogs

Regional. 13^b: 6 species at Hendon Park on 4 March 1990

l. Reptiles

State. 13^b: 13 species in a 4-hour rock survey at Hendon Park on 4 March 1990; highest single survey diversity on Merri Plains

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 13^b: over 120 species

b. Native birds

Regional. 13^b: over 90 species. **13^a:** over 50

c. Native mammals

Regional. 13^b: 10 species

d. Herpetofauna

Regional. 13^b: 20 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 13^b: 24 species. **13^a:** 15 species

b. Regionally endangered fauna (R1 species)

State. 13^a: 5 species. **Birds:** Little Button-quail, Cockatiel, Budgerigar, Regent Honeyeater. **Mammals:** Southern Freetail Bat

Regional. 13^b: 3 species. **Mammals:** Little Red Flying-fox. **Reptiles:** Eastern Bearded Dragon, Striped Legless Lizard

c. Regionally vulnerable fauna (R2 species)

State. 13^b: 6 species. **Birds:** Crested Pigeon, Spotted Harrier, Black Falcon, Zebra Finch, Diamond Firetail. **Mammals:** Fat-tailed Dunnart

Regional. 13^a: 4 species. **Birds:** Grey Goshawk, Black Kite, Barking Owl, Diamond Firetail

d. Regionally rare fauna (R3 species)

Regional. 13^b: 7 species. **Birds:** Great Crested Grebe, Collared Sparrowhawk, Little Corella, Masked Woodswallow, White-browed Woodswallow. **Reptiles:** Marbled Gecko. **Frogs:** Plains Froglet

Regional. 13^a: 2 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift

e. Regionally depleted fauna (R4 species)

Regional. 13^b: 7 species. **Birds:** Brown Quail, Swamp Harrier, Rainbow Bee-eater, White-winged Triller, Striated Fieldwren, Rufous Songlark. **Reptiles:** Red-bellied Black Snake

Regional. 13^a: 5 species. **Birds:** Australian King-Parrot, White-winged Triller, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 13^b: 20 species. **Birds:** Pied Cormorant, Banded Lapwing, Royal Spoonbill, Cattle Egret, Nankeen Night Heron, Australian Shelduck, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brown Songlark, Singing Bushlark. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

Regional. 13^a: 10 species. **Birds:** Great Egret, Cattle Egret, Little Eagle, Barn Owl, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brown Songlark, Singing Bushlark. **Frogs:** Common Spadefoot Toad

g. Nesting birds of prey/parrots

Regional. 13^b: Budgerigar, Spotted Harrier and Black Falcon at Hendon Park. **13^a:** Purple-crowned Lorikeet and Long-billed Corella at Craigieburn Road East

F. POPULATION DENSITY: Viability and Abundance—point census

g. Restricted colonial fauna

Regional. 13^b: 150 Australian White Ibis at Hendon Park in May 1990

l. Regionally vulnerable fauna (R2 species)

Regional. 13^b: 6 Zebra Finches at Vearings Road by Hendon Park on 6 November 1991

m. Regionally rare fauna (R3 species)

Regional. 13^b: 15 breeding pair of White-browed Woodswallows at Hendon Park on 6 November 1991

o. Regionally restricted fauna (R5 species)

Regional. 13^a: 10 Long-billed Corellas at Stornicroft in December 1991

Outlook

Interconnecting River Red Gum and understorey shrub revegetation plots and protection from fox predation for the rare herpetofauna species would maintain State significance in the long term. Stony sections supporting the important herpetofauna assemblage should be protected.

FAUNA

Rare or Threatened Fauna

Ba **13^a: Regent Honeyeater.** Single bird observed in farm garden adjoining River Red Gum grassy woodland (14.1) at Stornicroft in 1986 (Mavis Doherty pers. comm.).

Bb **13^b: Striped Legless Lizard.** One was located in Kangaroo Grass stony knoll grassland (22.1) surrounded by River Red Gum grassy woodland (14.1) at Hendon Park on 4 March 1990. It was under a flat rock on a stony rise in the north-eastern section (south of the stone wall boundary fence). Continuous rocky plains grassland habitat in the site connects west to areas in the Craigieburn Grassland site. This lizard has not been recorded in River Red Gum grassy woodland elsewhere in GM and its presence in this site is of scientific interest.

Bc **13^a: Grey Goshawk and Barking Owl.** The goshawk is seen occasionally in River Red Gum grassy woodland (14.1) at Stornicroft as a late summer–autumn visitor (probably dispersing juveniles from upland breeding grounds) and the Barking Owl is resident (Mavis Doherty pers. comm.).

Bc **13^b: Black Falcon breeding at Hendon Park.** This bird of prey is associated with the low rainfall volcanic plains of GM, particularly lightly timbered watercourses. They appear to be resident on the Werribee Plains. In years of bountiful rain (and quail) adults visit the Merri Plains in the breeding season. In NEM they are more often seen as single birds during autumn–winter. The only confirmed breeding observation in NEM in

the last decade was a pair in a stick nest in River Red Gum grassy woodland (14.1) in spring 1988 (Chris Vearing pers. comm.). A single bird was seen in February 1990 coursing over Kangaroo Grass plains grassland (23.2) along Vearings Lane at Hendon Park in search of Stubble Quail (the most important prey item). There were a number of spring sightings in NEM (e.g. Yarra Valley Park in site 57) and it is likely that these birds nest occasionally.

Small irruptions of breeding adults enter NEM during inland droughts (e.g. 1977 and 1978, arriving in early October in the Plenty Gorge). These were successive drought years in the inland and the latter was wet in southern Australia. The population which built up during the big floods of 1974–75 left the inland for the southern coast (also Black and Letter-winged Kites). This climatic pattern repeated to a smaller scale in 1990/91.

Similar to the Black Kite, Black Falcons are attracted by the smoke of grassfires and late summer stubble burn-offs (Emison *et al.* 1987). They snatch prey from the ground, grass or water or when flushed from close overhead while in a low glide. The largest of the Australian falcons, the female (falcon) is considerably larger and less agile than the male (tercel). While the female incubates the eggs and tends the young until they are fairly strong, the male does the hunting. His prey is predominantly Stubble Quail and small grassland passerines. The female later joins in hunting and provides larger prey such as waterbirds and magpies.

While present in the Plenty Gorge in the late 1970s, they seldom took prey from the vicinity of trees and shrubs and always hunted on the open volcanic plains to the west of the river. They would spend considerable periods of the day scanning for prey from an open perch on top of a tree, broken by short hunting glides and periods of circling overhead.

Black Falcons have also been recorded in the Merri Valley over Common Tussock-grass–Rush Sedge seasonal wetland (25.2; sites 2 and 12). These are most productive for quail. They have also been seen over cropland. With closer settlement and more intense grazing regimes brought on by farmlet subdivision since the 1970s, the abundance of Stubble Quail has declined appreciably in NEM., the falcon, and the quail, persisting in any number only on the broad-acre grassy woodland plains between Craigieburn, Wollert and Beveridge.

Critical Assemblages or Populations

Cl **13^b: High diversity of reptiles.** A 4-hour herpetofauna survey was conducted in the north-east section of Hendon Park on 4 March 1990. Habitats searched included River Red Gum grassy woodland (14.1), Kangaroo Grass stony knoll grassland (22.1) and Kangaroo Grass plains grassland (23.2). Most of the 13 species recorded, including the Striped Legless Lizard (see *Bb*), were under rocks. Other significant species included the Marbled Gecko (one in rock wall), Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink and Little Whip Snake. A Lowland Copperhead was located in the stony rises at the headwaters of a rocky tributary of Edgars Creek, west of Vearings Road. A Southern Lined Earless Dragon was observed later in the day in a rock wall at the western boundary with Craigieburn Grassland (see site 10). The area contains 20 species of reptiles and frogs. Three others including the Bibron's Toadlet observed in **13^a** are likely also present.

Other Significant Fauna

Birds

- Eb* **13^a: Little Button-quail and Cockatiel at Storncroft.** These enter NEM from the inland during droughts. Sporadic irruptions of the Little Button-quail and Cockatiel have been recorded at Storncroft along Craigieburn Road East (Mavis Doherty pers. comm.). The Cockatiel was seen after a rainy spell in mid-December 1991, following a very wet local winter–spring and an inland drought (Mavis Doherty pers. comm.). Black Kites (*Ec*) are also seen in these years.
- Eb* **13^b: Budgerigar and other nesting parrots in the River Red Gums.** Every three to four years Budgerigars enter the River Red Gum grassy woodland (14.1) of the volcanic plains as spring migrants from inland areas. They were seen during the survey period in 1988 at Hendon Park to the south-west of Wollert and in 1991 at Boonderoo to the north-west of Wollert (site 14). About 10 pair were observed nesting at Boonderoo while at least one pair nested at Hendon Park (Chris Vearing pers. comm.). The old River Red Gums support

many species of hollow nesting birds. Fourteen species of parrots have been recorded in the site, six of which were breeding.

Ec **13^b: Spotted Harrier breeding at Hendon Park.** This is an irruptive bird of prey from inland Australia. It is normally recorded as a non-breeding visitor in late summer–autumn. A pair bred in a stick nest in River Red Gum grassy woodland (14.1) in spring 1988 (Chris Vearing pers. comm.).

Ec **13^b: Zebra Finch and Diamond Firetail.** Six Zebra Finches were seen on a closed roadside (Vearings Road) at a ford along a tributary of the Edgars Creek on 6 November 1991. The tributary contained **River Red Gum (plains) drainage line woodland (30.1)** The roadside contained ungrazed Kangaroo Grass stony knoll grassland (22.1). The finches had built two flask-shaped nests amongst a Tree Violet and Hedge Wattle. Flocks of up to 10 birds were seen further north at Storncoft in the wet years of 1970–75 (Mavis Doherty pers. comm.).

The Diamond Firetail, which has become rare in NEM, also breeds in shrubs along the roadsides (Chris Vearing pers. comm.). A small party of four or five was seen along Vearings Road in January 1994 near where the Zebra Finches were recorded on Vearings Road. They were feeding on seeds of Veined Swamp Wallaby-grass along the creek bank. Both species of finches are usually found near water.

Ed **13^b: Masked and White-browed Woodswallow at Hendon Park.** They irrupt into River Red Gum grassy woodland (14.1) on the Merri and Plenty Plains during spring–summer of dry years in the inland. Fifteen breeding pair of White-browed Woodswallows were recorded in the north-eastern section of Hendon Park on 6 November 1991. The Masked Woodswallow was also present but was not observed breeding. The late winter to early summer period was wet locally and irruptions of many inland species occurred.

Ee **13^b: White-winged Triller and Rufous Songlark at Hendon Park.** Like the woodswallows, these irrupt into River Red Gum grassy woodland (14.1) on the Merri and Plenty Plains during spring–summer of dry years in the inland. Both were observed breeding in the north-east section of Hendon Park on 6 November 1991. The Rufous Songlark had also been observed in the late 1980s (Chris Vearing pers. comm.).

13^b: Winter floodplain waterbirds. In the winter–spring of wet years (e.g. 1991) the Edgars Creek red gum floodplain carries a broad area of shallow water for short periods and ibis, spoonbills, herons, waterfowl and other waterbirds appear on the freshwater meadows. These include the Nankeen Night Heron and Swamp Harrier.

13^a: Peaceful Dove and Blue-faced Honeyeater in the 1970s at Storncoft. The Peaceful Dove and Blue-faced Honeyeater visited after the inland floods of 1974-75. A single Blue-faced Honeyeater bird was seen south-west of Wollert in a farm garden near River Red Gum plains woodland during the wet spring of 1975 (Mavis Doherty pers. comm.). The previous year had seen big floods and a boom breeding season in the Murray Valley and after these conditions this species (and others such as the Peaceful Dove) apparently temporarily expanded in range.

13^b: Locally extinct Southern Stone-curlew. The last birds died out at Hendon Park around 1940 (Beatrice Vearing pers. comm.). This was one of the last known pairs in NEM (see site 20).

Mammals

Eb **13^b: Little Red Flying-fox.** One was caught in a tree net while taking ripened fig fruit in the farm garden at Hendon Park in February 1990 and was identified by staff of the Royal Melbourne Zoo (Chris Vearing pers. comm.). This is the only record for the species in GM during the survey period. It is likely that small numbers visit GM from northern Victoria (the nearest colonies are in the mid-Murray River valley) in search of orchard fruit during late summer.

Eb **13^a: Southern Freetail Bat.** Six species of bats were captured in River Red Gum grassy woodland (14.1) by tripline at the dam near the corner of Craigieburn Road East and Vearings Road on 8 December 1991. The Southern Freetail Bat (long penis species) has only been trapped in grassy woodland in GM. The related Southern Freetail Bat and the Inland Broad-nosed Bat, which both associate with streams and riparian forest/woodland, were not recorded (see Fenwick and Surrounds and Bald Hill sites). Further trapping should be conducted to determine if either species is present.

Ec **13^b: Fat-tailed Dunnart.** An old nest was located in Kangaroo Grass stony knoll grassland (22.1) in the north-eastern section of Hendon Park on 4 March 1990.

Reptiles

Eb **13^b: Eastern Bearded Dragon.** Recorded by Vearings Road in the late 1980s (Chris Vearing pers. comm.). This is likely to be one of only a few remaining natural populations in GM.

Frogs

Ed **13^b: Plains Froglet and other winter–spring floodplain frogs.** In the winter–spring of wet years the Edgars Creek red gum floodplain (14.1) carries a broad area of shallow water for short periods. The Plains Froglet and Common Spadefoot Toad inhabit the floodplains. The toad was recorded at Hendon Park on 4 March 1990 and near the corner of Vearings Road and Craigieburn Road East on 23 May 1990. The Bibron’s Toadlet was calling near a dam by the corner of Vearings Road and Craigieburn Road East on 23 May 1990. The Plains Froglet, which is common in the upper Plenty River and Merri Creek floodplains to the north and in the Goulburn River plains across the Great Divide in northern Victoria, is at its southern range limit. It was recorded in Brown-back Wallaby-grass seasonal wetland (25.3) at a floodplain depression along O’Herns Road on 24 November 1988.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. There is an intact habitat link to/between the Craigieburn Grassland site and the Summerhill Road site and a partial link to the Epping to Wollert site and Fenwick and Surrounds site. The site links Craigieburn Grassland to the west with the Darebin and Barber Creek grassy woodlands to the north-east. The Edgars Creek site possibly functions as a dispersal route between these two areas.</p> <p>Strengthen Strategic Habitat Link. The north-east section of Hendon Park contains a fine stand of River Red Gums and numerous stony knolls. The western section links directly to the Craigieburn Grassland site. Both sections are integral to the maintenance of faunal values in the proposed Volcanic Plains Ecological Reference Area at Craigieburn. If pressure to subdivide Hendon Park into farmlets occurs in the future, these sections (at least 33% of the property) need to be incorporated into a public open space conservation area. This should be managed as a conservation buffer zone to the Craigieburn Grassland.</p>	
<p>See sites 10, 15 and strategies in Volume 1. The broad issues are:</p> <p>Inadequate conservation incentives and conservation management.</p>	<p>See sites 10, 15 and strategies in Volume 1. The broad issues are:</p> <p>Revegetation, tree planting, protection of significant habitat and habitat links.</p>

Residential encroachment—increasing farm rates—pressure to subdivide.

River Red Gum dieback and lack of replacement trees.

Broad-acre subdivision into farmlets—strict conservation guidelines required.

Plenty–Merri River Red Gum Protection Zone.

Protect rocks and native grassland as they are critical for ground fauna and flora.

Regional Hydrological Strategy

Wetland/creek conservation—exclusion of livestock grazing.

Conservation Measures for Other Issues

Formation of community land protection group.

Provision of financial incentives and technical assistance for land protection works.

Closed road conservation and land-use strategy. Significant native vegetation occurs along Vearings Road and O’Herns Road. Cessation of stock grazing on the road reserves would enable regeneration to occur. Closed roads contain the best field layer vegetation and only indigenous shrub layer vegetation remaining in the site. These habitats provide homesites for some species (e.g. Zebra Finches, White-fronted Chats, Flame Robins and Diamond Firetails) which may otherwise be absent from the site. The verges should be linear conservation areas serving as habitat links.

A strategy to protect the grassland remnants should be devised. The strategy should contain guidelines for revegetating the River Red Gums and planting missing tall shrub layer vegetation (Drooping Sheoke, Tree Banksia, Tree Bursaria, Lightwood and Blackwood). Broad strips (at least 20 m) inside paddocks fronting onto the verges should be fenced and replanted so as to form a local habitat link network. This would allow the development of faunal corridors of greater width, diversity and function. This may enable some species which have been eliminated (e.g. Southern Whitefaces, Rufous Whistlers, Golden Whistlers and Common Bronzewings) to return. Some of these are important control agents of leaf defoliating insects.

Implementation of Native Vegetation Clearance Controls on private land.

Site 14 Summerhill Road

Map Reference:	7822 225391 ('Gas and Fuel' Swamp); 7822 226410 ('Woody Hill' Swamp); 7822 233401 ('Boonderoo' woodlands). One minute lat/long grids include 37° 33' x 144° 58' to 145° 00', 37° 34' x 144° 58' to 145° 01', 37° 35' x 144° 58' to 144° 59' and 37° 36' x 144° 58'.
Location/Size:	To the east of the Merri Creek and between Craigieburn Road East and Donnybrook Road. Approximately 2200 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: Gas and Fuel Corporation land. Private: zoned rural and extractive, the latter owned by Craigieburn Clay and smaller companies including Pakenham Blue Metal. Combination of farmlets and broad-acre farm settlement with sheep and cattle grazing.
Landforms:	Volcanic plain (see MLVP D). Elevation is 180–230 m.

Natural Heritage Values

Landscape. The stony rises, stony plains swamps, ephemeral creek valley/floodplains and their grassland, grassy wetland and their grassy woodland vegetation are fine illustrations of the natural character of the volcanic plains landscape. The River Red Gum grassy woodland at the rear of Boonderoo and adjacent properties contains the highest proportion of mature and healthy trees seen in NEM. Many of the River Red Gums are estimated to be over 500 years old. There are numerous tree-hollows. As evidenced by stumps and scattered trees, there were formerly extensive stands of Drooping Sheoke, in likely association with Tree Banksia, on the stony knolls.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: Common Tussock-grass plains grassland (23.1)

Relatively intact and extensive stands: River Red Gum (volcanic plain) grassy woodland (14.1); Kangaroo Grass stony knoll grassland (22.1); Common Spike-sedge drainage line herbfield (24.1; Summer Hill drainage line); Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2; Woody Hill Swamp and Gas and Fuel Swamp); Brown-back Wallaby-grass seasonal wetland (25.3)

Partially intact or small stands: Kangaroo Grass plains grassland (23.2; grazing land)

Endangered species: Tough Scurf-pea (amongst *Poa* tussocks on the terraces and plain-slopes of Summer Hill drainage line)

Vulnerable species: Curly Sedge (Summer Hill drainage line)

Rare species: Blown Grass (*Agrostis aemula* var. *setifolia*; gilgais at Woody Hill Swamp), Swamp Wallaby-grass (*Amphibromus* sp. aff. *nervosus*; Woody Hill Swamp and Gas and Fuel Swamp), Dusky Scurf-pea (with Tough Scurf-pea)

Critical assemblages or populations: Strategic Habitat Link, critical in maintaining population viability of grassland fauna at Craigieburn Grassland and areas such as Bald Hill Grassland to the north along Merri Creek. Substantial population of the Tough Scurf-pea and Curly Sedge along Summer Hill drainage line/plain-slopes. The drainage line and swamps support the most extensive stands of significant vegetation and flora species. Woody Hill Swamp and Gas and Fuel Swamp formed in lava flow blockages (one flow later crossed by another forming a land-locked basin). They have pronounced gilgai topography and support 25.2 and 25.3. The stand of grassy woodland on Boonderoo and adjoining properties to the east and north is one of the most extensive, mature stands of River Red Gum on the volcanic plains

Notable features: smaller areas of significant species and habitats are widespread. These include remnant grassland on 'paddock' stony knolls at Boonderoo and adjoining properties.

FAUNAL SIGNIFICANCE: Site 14 Summerhill Road

Assessment: State—Category 3 (B, C, E); Regional (C, D, E)

Reference grids for the significance keys include:

14^a: 37° 34' x 144° 59'; Woody Hill and Gas and Fuel Swamps/Boonderoo

14^b: 37° 35' x 144° 58'; Summer Hill drainage line north of Craigieburn Road East

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 14^b: Eastern Barred Bandicoot (Summer Hill drainage line in 1930s)

b. Vulnerable fauna

State. 14^a: Plains-wanderer (Gas and Fuel Swamp in 1988); Swift Parrot (small flock in River Red Gums east of Boonderoo in spring 1990)

Unranked. 14^a: Southern Stone-curlew (1930s), Superb Parrot (1940s) and Grey-crowned Babbler (1950s); Boonderoo area

c. Rare fauna

Regional. 14^a: Red-chested Button-quail

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 14^a: 14 species at Woody Hill Swamp on 28 November 1991

f. Breeding migratory insectivores

Regional. 14^a: 9 species including the Rufous Whistler, White-winged Triller, Rufous Songlark and White-browed Woodswallow in River Red Gums at Boonderoo on 28 November 1991

g. Breeding parrots

State. 14^a: 10 species including the Little Lorikeet, Purple-crowned Lorikeet, Budgerigar, Crimson Rosella and Long-billed Corella in River Red Gums at Boonderoo on 28 November 1991

h. Bats

Regional. 14^a: 7 species including the Chocolate Wattled Bat and Southern Forest Bat trapped under River Red Gums at Boonderoo on 9 and 10 December 1991

j. Reptiles

Regional. 14^a: 6 species including the Cunningham's Skink, Bougainville's Skink and Little Whip Snake on the stony crests to the west of Gas and Fuel Swamp on 28 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 14^a: over 110 species

b. Native birds

Regional. 14^a: over 90 species

c. Native mammals

Regional. 14^a: 12 species

d. Herpetofauna

Regional. 14^a: 13 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 14^a: 21 species

b. Regionally endangered fauna (R1 species)

State. 14^a: 4 species. **Birds:** Red-chested Button-quail, Plains-wanderer, Budgerigar, White-backed Swallow

c. Regionally vulnerable fauna (R2 species)

Regional. 14^a: 5 species. **Birds:** Spotted Harrier, Black-eared Cuckoo, Southern Whiteface, Diamond Firetail.
Mammals: Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 14^a: 3 species. **Birds:** Hardhead, Little Corella, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 14^a: 9 species. **Birds:** Brown Quail, Latham's Snipe, Swamp Harrier, Swift Parrot, Peregrine Falcon, White-winged Triller, Rufous Songlark, Striated Fieldwren. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 14^a: 14 species. **Birds:** Royal Spoonbill, Australian Shelduck, Little Eagle, Long-billed Corella, Purple-crowned Lorikeet, Little Lorikeet, Rose Robin, Brown Songlark, Singing Bushlark. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake

g. Nesting birds of prey/parrots

Regional. 14^a: Little Lorikeet, Purple-crowned Lorikeet, Budgerigar and Long-billed Corella (River Red Gum hollows at Boonderoo in November 1991)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 14^a: 10 Latham's Snipe at the Gas and Fuel Swamp on 4 October 1991

c. Waterfowl

Regional. 14^a: several hundred waterfowl on the combined wetlands of Woody Hill Swamp and Gas and Fuel Swamp in September 1991

m. Regionally rare fauna (R3 species)

Regional. 14^a: over 10 pair of White-browed Woodswallows breeding in the River Red Gums at Boonderoo on 28 November 1991

n. Regionally depleted fauna (R4 species)

Regional. 14^a: about 10 pair of Rufous Songlarks and over 10 pair of White-winged Trillers breeding in the River Red Gums at Boonderoo on 28 November 1991

Outlook

The site fulfils State Category 3 faunal significance but also satisfies a further 14 sub-criteria for Regional significance (Category 1) covering birds and mammals for both faunal rarity and diversity and reptiles for faunal diversity. The faunal significance is declining due to inadequate conservation management. Addressing the issues raised under Threatening Processes would maintain and be likely to increase the significance.

FAUNA

Rare or Threatened Fauna

Bb 14^a: Plains-wanderer. One was seen by a local quail shooter in 1988 in wallaby-grass grazing land (ex-Kangaroo Grass plains grassland; 23.2) at the rear of the Gas and Fuel site, south of Summerhill Road. This area forms part of the headwater catchment of Summer Hill drainage line. Further survey should be undertaken to ascertain the importance of the site for the Plains-wanderer.

Bb 14^a: Swift Parrot. A small flock visited River Red Gum grassy woodland (14.1) north of Boonderoo in spring 1990 (Chris Vearing pers. comm.).

Bc 14^a: Red-chested Button-quail. One flushed from Kangaroo Grass stony knoll grassland (22.1) fringing the southern section of Woody Hill Swamp on the Pakenham Blue Metal land.

14^a: Locally and regionally extinct species. The Bush Stone-curlew was present in the Boonderoo area until the 1930s while the Grey-crowned Babbler persisted until the 1950s (Bill Payne pers. comm.). The babblers bred in Drooping Sheoke which was locally common on the stony knolls. Superb Parrots bred in River Red Gum grassy woodland until the 1940s (Evelyn Draper pers. comm.). The Eastern Barred Bandicoot and Eastern Quoll persisted in the Gas and Fuel Swamp/Summer Hill drainage line area until the 1930s (Bill Payne pers. comm.).

Critical Assemblages or Populations

Cg 14^a: High diversity of nesting parrots in River Red Gums at Boonderoo. The stand age is estimated to be several hundred years. The quantity and quality of tree hollows available provide one of the highest diversities of nesting parrots (10 species) recorded in GM. These were recorded in River Red Gum grassy woodland (14.1) at the rear of Boonderoo on 28 November 1990. Species included the Long-billed Corella, Crimson Rosella, Budgerigar and the Purple-crowned, Little and Musk Lorikeets (also attracted by the flowering River Red Gums).

Other Significant Fauna

Birds

Eb 14^a: Budgerigar. Two were nesting in a spout in River Red Gum grassy woodland (14.1) at the rear of Boonderoo on 28 November 1991. About 20 nested in the 1983 drought (Evelyn Draper pers. comm.). They are an irregular and irruptive late spring–summer visitor from inland Australia into the grassy woodland plains of GM. The species was sighted at Yarrambat in the Plenty Gorge in summer 1977–78 and 1978–79. At these times they were probably also elsewhere on the River Red Gum plains of NEM. They are dependent on water and enter higher rainfall coastal areas during inland drought years. Flocks of up to 50 birds have been recorded near Bacchus Marsh and the You Yangs. They are communal in breeding and feeding activity.

Their main food is seeds of field layer plants, particularly grasses and herbs, taken from the ground or while climbing (Readers Digest 1986). Food plants in the Plenty Gorge were the seeds of grasses such as the native Weeping Grass and introduced Toowoomba Canary-grass and of introduced herbs including Prostrate Knotweed and Spear Thistle. Unlike most other parrots, they feed in hot weather through the day. At Yarrambat they would drink and bathe in the shady rock pools and riffles at the top end of the main pool.

The population of Budgerigars that visit GM is isolated from the normal range of the species in northern Victoria (Emison *et al.* 1987). They have always visited Melbourne (Batey 1907). Blakers *et al.* (1984) report an extension to their inland range due to the availability of food and water. It appears that the species had retreated from GM by the mid-twentieth century as native food was lost through clearing, swamp draining, livestock grazing and land cultivation. Their range may be slowly advancing again as the result of a switch to an exotic diet (similar to other granivores such as the Long-billed Corella).

Eb 14^a: White-backed Swallow. Three were seen sitting on powerline wires along Summerhill Road amongst a flock of Tree and Fairy Martins in pre-migratory behaviour on 6 March 1990. The swallow nested in the 1982/83 drought at a gravel quarry in site 20. They are another rare species characteristic of the inland. Near the You Yangs, White-backed Swallows nest near water in gravel pits and eroded vertical banks of **River Red Gum (plains) drainage line woodland (30.1)** along drainage lines.

Ec 14^a: Black-eared Cuckoo. One in River Red Gum grassy woodland (14.1) at Boonderoo on 28 November 1990.

Ec 14^a: Southern Whiteface and Diamond Firetail. A pair of each was observed amongst a patch of Drooping Sheoke and Hedge Wattle in Kangaroo Grass stony knoll grassland (22.1) east of Boonderoo on 6 March 1990. These dry country species are more common west of Melbourne and are largely restricted in NEM to the Merri Plains, where they are very rare.

Ed/Fc 14^a: Hardhead and other waterbirds during a wet winter–spring at Woody Hill and Gas and Fuel Swamps. A pair of Hardhead was present at Woody Hill Swamp on 28 November 1991. The swamp was becoming dry but still contained water in pools. The vegetation of both swamps is Common

Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2) in the central sections and Brown-back Wallaby-grass seasonal wetland (25.3) on the fringes and in gilgais. During winter and until mid-October 1991 most of the low-lying meadows and swamps were inundated after heavy rains. They carried several hundred waterfowl (particularly Australian Shelduck, Pacific Black Duck and Chestnut Teal). Other waterbirds included ibis, herons, egrets and spoonbills. The Gas and Fuel Swamp on Summerhill Road contained 10 White-faced Herons and 20 Australian White Ibis on 4 October 1991.

- Ee* **14^a: Brown Quail.** One was calling at dusk from Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2) at Gas and Fuel Swamp on 4 October 1991. The stand of Common Tussock-grass plains grassland (23.1) that stretches south from the swamp to Craigieburn Road East is the most extensive area of this habitat in NEM. It is important for Stubble Quail and supports the Plains-wanderer (see above).
- Ee* **14^a: Swamp Harrier, Peregrine Falcon and Striated Fieldwren.** Each was seen near Woody Hill Swamp on 28 November 1991. The falcon was in River Red Gum grassy woodland (14.1) north-west of the swamp. The harrier was seen over the swamp and the fieldwren was present in Common Tussock-grass–Rush Sedge seasonal wetland (25.2).
- Ee* **14^a: White-winged Triller and Rufous Songlark.** About 10 pair of both species, resulting from an influx caused by an inland drought, were nesting in River Red Gum grassy woodland (14.1) at the rear of Boonderoo on 28 November 1990. The stand at Boonderoo and adjacent properties contained several species of inland Victorian birds which are rare in NEM, particularly breeding. Their presence is influenced by the proximity of the Kilmore Gap. Other inland avifauna visitors to Boonderoo include the Purple-crowned Lorikeet, Budgerigar, Black-eared Cuckoo and White-browed Woodswallow (*Ed*; over 10 pair nesting).
- Ef* **14^a: Rose Robin and other locally rare forest birds at Boonderoo.** A Rose Robin briefly visited a farm garden while in passage in late September 1989 (Evelyn Draper pers. comm.). The Rufous Whistler, Varied Sittella and Spotted Pardalote, which are typically forest birds that are rare or absent from River Red Gum grassy woodland (14.1), were present and breeding on 28 November 1991.
- Fa* **14^a: Latham's Snipe.** Ten were present in Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2) and Brown-back Wallaby-grass seasonal wetland (25.3) at Gas and Fuel Swamp on 4 October 1991. Similar numbers also visit the Woody Hill Swamp in wet springs. In these years the black soil swamps of the area may contain a population of 30 or more snipe and so qualify as protected habitat under international migratory bird agreements.

Mammals

- Ec* **14^a: Fat-tailed Dunnart.** A breeding female with pouched young was located under a rock in Kangaroo Grass stony knoll grassland on Pakenham Blue Metal on 28 November 1991.
- 14^a: Bats of the River Red Gum woodlands at Boonderoo.** Seven species were recorded during bat trapping under River Red Gum grassy woodland (14.1) on 9/10 December 1991, despite inclement weather. These included the Chocolate Wattled Bat and Southern Forest Bat. On the basis of the quantity and quality of tree hollows available, additional species would likely be present. These should include the Southern Freetail Bat (trapped nearby in grassy woodland in site 13) and possibly the Eastern Freetail Bat (grassy woodland in site 15) and Inland Broad-nosed Bat (riparian/grassy woodlands at sites 4 and 15).

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. There are intact grassland habitat links south to the Craigieburn Grassland site and Edgars Creek Headwaters site, north to the Bald Hill site and west to the Craigieburn to Donnybrook site and woodland links east to the Fenwick and Surrounds site. There is a fragmented link to the Epping to Wollert site.

Strategic Habitat Link. The site forms an intact and important habitat link for grassland and grassy woodland fauna within the Merri Plains and forms the most intact link between the Merri and Plenty Volcanic Plains. It is accordingly nominated as a Strategic Habitat Link in NEM. The protection and enhancement of this habitat link is considered critical for the connectivity of volcanic plains faunal populations and the viability of these in the long-term. The function of the site as a habitat link will need to be addressed during planning considerations for any development or extractive proposal.

Lack of regeneration of River Red Gums. The average age of the River Red Gums would suggest that the stand vigour will go into decline over coming decades. A cause for concern is that few regenerating saplings, or indeed trees under 150 years old, are present.

Fencing enclosures to promote regeneration. Significant stands of native grassland, shrubland and grassy woodland on private land should be protected and placed under conservation management. Grazing exclusion plots established under the River Red Gums would enable regeneration and replanting of understorey shrubs. This is essential to provide habitat for insectivorous birds involved in the regulation of eucalyptus dieback (see the Fenwick and Surrounds site). Grants and external assistance should be sought to assist landowners in undertaking these works. Similarly, financial incentives such as rate rebates should be considered for properties conducting appropriate conservation management.

Plenty–Merri River Red Gum Protection Zone. This relates to the stand of River Red Gums in the north-east of the site (see site 15). The stand on the north-eastern section of Boonderoo and adjoining properties forms the western section of the River Red Gum woodlands that stretch east across the Plenty Lowland Volcanic Plains to Yan Yean. This is the largest and most intact area of River Red Gum in GM. The section in the Summerhill Road site forms the most extensive stand of River Red Gum on the Merri Plains. A ‘LandCare’ group of local landowners will need to form if long-term enhancement of biological values is to be realised.

Rock clearing, pasture improvements and farmland subdivision. Rocks are being extracted for urban landscaping from paddocks in many sections in the district. This is causing widespread loss and fragmentation of grassland ground fauna habitat. The activity has become a growth industry

Mining regulations and native grassland/rock clearance controls. The Mines Act regulates the commercial mining of non-renewable resources in Victoria. The commercial growth industry surrounding the extraction or surface stripping of basalt rocks, particularly for cosmetic purposes such as landscaping, needs to be similarly regulated. Stony rises, stony crests and rocky escarpments are the most significant areas for the native ground fauna and flora of the volcanic plains grasslands. Areas known or suspected to support vulnerable or endangered grassland species are eligible for protection under State and Commonwealth Government legislation (e.g. Flora and Fauna Guarantee Act of Victoria). Surface stripping should be curtailed in biologically significant areas of the volcanic plains.

Any mining proposal needs to be accompanied by a full and independently reviewed environmental impact assessment which addresses the impacts on both biological and physical landscape values, including the hydrological cycle. Regulations will need to be formulated and enforced to protect the diminishing volcanic plains grassland habitat as less than 1% of the original extent is now considered intact. The removal of native grassland (e.g. for industrial, agricultural and construction purposes) within a designated site of State or higher biological significance should require a permit. Essential works (e.g. mining and agriculture) would be considered if they complied with the purposes of the Regional Hydrological and Habitat Link Strategies and the permit conditions determining appropriate environmental safeguards contained within an environmental impact assessment.

Regional Hydrological Strategy

Grazing/trampling at Woody Hill and Gas and Fuel Swamps. The meadows at the Woody Hill and Gas and Fuel Swamps are compacted and at times have been heavily grazed by sheep and cattle. The substrate of the Gas and Fuel Swamp is pugged.

Conservation management/land protection works at Gas and Fuel and Woody Hill Swamps. Areas adjacent to quarry boundaries and on the high pressure gas pipeline easement and the Gas and Fuel pumping station are reserved land. Most quarries in the area have a buffer zone of 800 m. The Gas and Fuel site contains significant stands of native habitat. Some rare plants are potentially present. The swamp, surrounding stony crests and the outlet drainage line require a vegetation survey. There is need for effective conservation management such as reduced livestock grazing pressure and the establishment of grazing exclusion plots. This would facilitate regeneration of woodland, grassland and grassy wetland plant species.

Land salination. Low-lying meadows on the Pakenham Blue Metal land and Boonderoo and around the Woody Hill Swamp show early stages of salting. In combination with livestock grazing and land cultivation, salt-tolerant herbs such as English Couch, Buck's-horn Plantain, Sea Barley-grass, Creeping Brookweed, Salt Pratia, Australian Salt-grass and Strawberry Clover are replacing less tolerant herbs such as Subterranean Clover, Poison Lobelia and Rough Raspwort. Bared areas containing a salt encrustation and salt springs have appeared over small sections of the land-surface. Swamp Gums are susceptible to salting and several old trees have recently died.

(See Salination in Volume 1)

Salinity—causes and controls. The key area in the control of the land salination and tree dieback involves the protection and, more importantly, the regeneration of the River Red Gums. Detailed hydrological and ecological investigation and monitoring needs to be conducted. Research into the local causes of salinity and tree dieback is required. Both should be considered essential in an Environmental Impact Assessment for the proposed quarry. Action to redress the level of salting is required. Left uncontrolled, the problem will likely advance into other areas where symptoms are not yet readily apparent (though predisposing factors have been long operating; see salinity section of the Regional Hydrological Strategy in Volume 1).

Other Issues

Poor land management of blocks such as the Pakenham Blue Metal land. Land management has led to severe weed invasion (e.g. Chilean Needle-grass, Bathurst Burr and Spanish Artichoke). Severe infestations occur on sections of the Pakenham Blue Metal land which are invading neighbouring properties. This land was part of a World War II soldier settlement subdivision of the original broad-acre Woody Hill property. Up to the time of subdivision, the property contained extensive areas of grassland and the large Woody Hill Swamp. The blue metal land has changed hands several times since the war and successive landowners have exacerbated the weed problem. For a period, tonnes of manure from a piggery near Diamond Creek were dumped and spread over the grassland. At other times there was severe overgrazing. Rocks were quarried during another period. Most of the activities have been restricted to the front section. Some of the middle section (where the quarry is proposed) and most of the rear section (adjoining Woody Hill Swamp) contain significant habitat.

Preconditions for the invasion of Chilean Needle-grass. See Chapter 8 in Volume 1.

High fox density. Numerous foxes were observed and heard while spotlighting/bat trapping in November 1991.

Conservation incentives to landowners will be required to achieve many of the habitat enhancement objectives.

Weed control. Removal of invasive noxious weeds such as Chilean Needle-grass, Bathurst Burr, Serrated Tussock and Spanish Artichoke from areas such as the Pakenham Blue Metal land is required.

Land-use and conservation plan for all significant areas of habitat.

Bluestone quarry proposal—Pakenham Blue Metal

An application for rock extraction license is being considered subject to the presentation of an acceptable conservation management plan by Pakenham Blue Metal. This is required to follow environmental guidelines under the Mineral Resources Development Act. Issues relating to application of the Flora and Fauna Guarantee, in particular impact on threatened flora and fauna species, are being considered by the Department of Natural Resources and Environment.

Survey and Environmental Impact Assessment of flora and fauna including ground fauna trapping should be required in the management plan. Approval for mining will be subject to successful application to Council for a planning permit under the Local Government Planning Scheme. The EIA would need to address the impact of the proposed quarry land on adjoining areas, particularly the River Red Gum grassy woodland at Boonderoo and the hydrological cycle of Woody Hill Swamp and Merri Creek. An important aspect is the effect on productivity of local farms, particularly those dependent on bore water. If the operation commences, these parameters will require successive monitoring. Early stages of land salination and advanced weed infestations have been observed in the area. Land and water salination and weed control management plans should be prepared in the EIA.

Blue Metal Quarry—effect on the hydrological cycle. The proposed quarry will be one of the largest of its type in Victoria. It is to be situated on a divide between the catchments of the Merri and Darebin creeks. The surface catchment is locally closed and consequently forms a substantial groundwater recharge area. The groundwater system may extend more than a 5 km radius beneath the surrounding area. It likely interconnects the Woody Hill and Gas and Fuel Swamps and surface and sub-surface flows of the Merri Creek and, possibly, the Donnybrook mineral springs. The watertable is high and several areas contain surface springs. The quarry will likely behave as a sump for ground and surface water. This may cause several deleterious effects including: lowering of the water table; increased salination of the groundwater and the Merri Creek; draining of local swamps and mineral springs and disruption of significant swampland ecosystems; and alteration of the flow of the Merri Creek and disruption of the significant instream ecosystem (see the Craigieburn to Donnybrook site).

Pakenham Blue Metal quarry—effect on vegetation. The River Red Gums on Boonderoo and surrounding properties including the north-west corner of the blue metal land are well within the 5 km radius 'lowered watertable area' of the proposed quarry. They have tapped into the watertable. The trees are old but relatively healthy. The viability of the stand may be at risk to altering ground or surface hydrology or salinity. A suggested option for removing surplus water from the quarry is by irrigation over surrounding lands. An increase in surface moisture or soil salinity has the potential to lower the vigour of the trees. In tandem with indirect effects such as insect/insectivorous bird related foliage dieback, there is potential for a proportion of the trees to die.

The area where the quarry is proposed contains significant stony knoll grassland (supporting the Fat-tailed Dunnart) and grassy wetland habitat (supporting the Latham's Snipe). It adjoins significant grassland and grassy woodland habitats. This proposal and any others which deliver groundwater over the land-surface or into the Merri Creek must be viewed with concern. Initial stages of salting have already been reached on the drylands and in the swamps and creeks and there is a likelihood that the isolated areas affected by salting will advance.

Blue Metal Quarry—effect on neighbouring land. The Pakenham Blue Metal quarry may 'dewater' nearby bores and the Woody Hill Swamp. It may exacerbate weed infestations. It may economically disadvantage neighbouring properties by lowering land productivity, profitability and value. The scope of the operation will lead to many sources of environmental disturbance including noise, dust and heavy vehicle operation on local roads.

PLENTY LOWLAND VOLCANIC PLAINS (PLVP)

Farmland catchments of the middle and lower Darebin Creek and middle Plenty River and its tributaries including Barber Creek.

Land use

Past land-use: pastoral and townships. Present land-use: pastoral, farmlets, urban (in south), rock extraction and recreation (e.g. horse riding).

Native vegetation cover

Extensive in north and highly fragmented in south.

Key biological features

The most significant species are the Red-chested Button-quail, Crested Pigeon, Latham's Snipe, Brolga, Masked Owl, Barking Owl, Purple-crowned Lorikeet, Long-billed Corella, Little Corella, Blue-winged Parrot, Rufous Songlark, White-browed Woodswallow, Inland Broad-nosed Bat, Southern and Eastern Freetail Bats. The most significant habitats are River Red Gum plains woodland and stony knoll grassland.

Of particular note are the faunal rarity and diversity (particularly Fenwick/Darebin Creek for bats, owls and parrots), and habitat rarity and abundance; River Red Gum critical conservation area; and strategic habitat link between the upland hills, alluvial plains and volcanic plains and lowland volcanic plains and hills (particularly Plenty River and River Red Gum belt between Yan Yean and Woodstock).

Key areas and physical features for biota

Fenwick and middle Darebin Creek woodlands/grasslands. Others localised occurrences include Epping Cemetery, rock walls/stony knolls, Quarry Hill, Bundoora Park and Darebin Parklands.

There are 10 sites of significance: 1 state and 9 regional for fauna and 1 very high 1 high and 8 medium for habitat.

PLVP A DAREBIN AND BARBER CREEKS

This management unit consists of one site of state faunal significance (site 15) and two of regional faunal significance (sites 16 and 17) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 290386 to 7922 246433 (Darebin Creek); 7922 324396 to 7922 267454 (Barber Creek); 7922 327353 to 7922 332378 (Plenty River).

Location/Size: Catchment of the Darebin Creek from Masons Lane Wollert to Donnybrook Road Woodstock; catchment of the Barber Creek from Plenty Road Mernda to Grants Road Eden Park; and the Plenty River from 1.3 km south of Bridge Inn Road to Masons Lane. Approximately 3600 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit lies at the southern foot of the Great Dividing Range on the volcanic plains of the Eastern Uplands. It includes the floodplains of the mid-section of the Darebin Creek and middle and lower sections of the Barber Creek.

Landforms

Foothill: plain-slopes (She Oak Hill) and river spurs (Plenty River). Volcanic plain: stony crests, stony rises, stony plains, silt plains, gilgai plains, swamps, swales, creek gorge (Plenty River), creek escarpment/floodplains (Darebin Creek), ephemeral rocky drainage lines, quarries, farm lakes and dams. Elevation is 140–260 m.

Hydrology

The unit contains the floodplains of the Darebin Creek, tributaries of the Plenty River (notably the Barber Creek) and a short section of the Plenty River. The Plenty River is perennial (see Plenty Gorge unit). The other streams are ephemeral, carrying water from winter to early summer and after runoff rain at other times of the year. The Darebin and Barber creeks contain columnar basalt cliffs, tessellated pavements, shallow, dry cobble and sand sections, rocky reefs and open water pools up to 1 m deep lined with reeds. Freshwater meadows occur at the aprons of extensive stony rises. Impoundments occur along the creeks (e.g. van Roosendael's dam and the dam on Jarat Park) and in the Pioneer Quarry at Wollert. There are several large farm dams on the plains in tributary headwaters (e.g. Silver Gum Park dam).

Rainfall: 630–680 mm.

Site 15 Fenwick and Surrounds

- Map Reference:** 7922 300399 (mid-point of census plots at Rockbank rear paddock); 7922 272388 (mid-point of census plots at Bournefield Park); 7922 288385 and 7922 280388 (census plots on Masons Lane); 7922 304404 (herpetofauna pitfall at Fenwick rear paddock); 7922 276397 (van Roosendael's Dam on Darebin Creek); 7922 290385 to 7922 251417 (Darebin Creek); 7922 324295 to 7922 313406 (Barber Creek); 7922 327353 to 7922 332378 (Plenty River). One minute lat/long grids include 37° 32' x 145° 04', 37° 33' x 145° 03' to 145° 05' and 37° 34' x 145° 01' to 145° 05'.
- Location/Size:** Area north-west of Mernda lying generally between the Epping–Wallan Road, Masons Lane, Plenty Road and Grants Road, incorporating sections of the Darebin and Barber Creeks. Approximately 1560 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: nil apart from roadsides. Private: part zoned Red Gum Protection (MPE 1989); remainder general farming. Some broad-acre sheep, cattle and horse stud farms along Donnybrook Road and Masons Lane, remainder farmlets.
- Landforms:** Volcanic plain (see PLVP A). Elevation is 180–200 m.

Natural Heritage Values

Landscape. The site contains the most extensive and significant stand of volcanic plains grassland in GM. The stand age averages 150–200 years and some individual trees are estimated to be over 500 years. Large properties (200–300 ha) remain, some held by 4th and 5th generation families. The broad-acre pastoral properties contain high biological and historical significance. The grassy ground layer maintains a high cover of Kangaroo Grass as well as a representative sample of other native species formerly typical of these grasslands (Molnar *et al.* 1989). The stone walls, buildings and Aboriginal artefacts are of considerable cultural heritage significance.

Scientific and Educational Values

Scientific reference. River Red Gum bird census plots on Masons Lane (plots 10 and 11), Bournefield Park on Masons Lane (plots 12 and 13), front of Fenwick Stud (plots 16 and 17) and the rear of Rockbank (plots 23, 24, 25 and 26).

HABITAT SIGNIFICANCE:

Assessment: Very High—Category 2

Reference stands: River Red Gum (volcanic plain) grassy woodland (14.1)

Relatively intact and extensive stands: Kangaroo Grass stony knoll grassland (22.1); Kangaroo Grass plains grassland (23.2; grazing land)

Partially intact or small stands: River Red Gum (drainage line) grassy woodland (14.4); Common Tussock-grass plains grassland (23.1); Common Spike-sedge drainage line herbfield (24.1); Brown-back Wallaby-grass (gilgai/swale) seasonal wetland (25.3); Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7); Blunt Pondweed permanent wetland (26.1)

Remnant, degraded or establishing stands: Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2)

Endangered species: Tough Scurf-pea (stony knoll north of Darebin Creek)

Vulnerable species: Curly Sedge (bank of Darebin Creek), Matted Flax-lily (terrace of Darebin Creek)

Rare species: Blown Grass (*Agrostis aemula* var. *setifolia*; gilgais), River Swamp Wallaby-grass (Darebin floodplain wetland), Pale Swamp Everlasting (as preceding), Slender Tick-trefoil (stony knolls and Darebin Creek escarpments)

Critical assemblages or populations: Strategic Habitat Link. River Red Gum Critical Conservation Area: Fenwick Stud, Rockbank, Barbers Creek to the east and Darebin Creek to the south-west support the most extensive stand of River Red Gum grassy woodland in GM and one of the most intact stands (Fenwick Stud and Rockbank) in Victoria. The CCA also supports one of the most intact (in terms of significant flora species) and extensive stands of plains grassland and stony knoll grassland in NEM. Communities associated with grassy woodland on properties, including Findon Park, sharing a boundary with Fenwick Stud and the Darebin Creek and adjacent sections at the rear of Fenwick Stud and Gilghi are considered the most intact. Stony knolls supporting a high diversity of significant grassland plants are widespread in this area and seasonal drainage line swamps and gilgais near the Darebin Creek contain rare grassy wetland species. The north (Donnybrook Road) section of Fenwick Stud contains the most intact stands of broad-acre plains grassland/grazing land (dominated by Kangaroo Grass and Velvet Tussock-grass).

FAUNAL SIGNIFICANCE: Site 15 Fenwick and Surrounds

Assessment: State—Category 3 (B, C); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

15^a: 37° 33' x 145° 04'; Fenwick Stud Donnybrook Road frontage

15^b: 37° 34' x 145° 02'; Darebin Creek/Findon Park/Bournefield Park

15^d: 37° 34' x 145° 04'; rear Fenwick Stud/Rockbank

15^e: 37° 34' x 145° 05'; Jarat Park/Sevenoaks/Barber Creek

A. Cited Zoological Significance

Regional. Plenty–Darebin River Red Gum woodlands: Beardsell (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. **15^d:** Red-chested Button-quail, Barking Owl (breeding), Powerful Owl, Masked Owl

Regional. **15^a:** Barking Owl. **15^b:** Brolga

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. **15^b:** 24 species (11 species of waterfowl) at van Roosendael's dam on the Darebin Creek on 4 October 1991

d. Breeding waterfowl

Regional. **15^b:** 7 species including the Eurasian Coot, Black Swan, Australasian Shoveler, Grey Teal and Chestnut Teal at van Roosendael's dam on 4 October 1991

f. Breeding migratory insectivores

Regional. **15^d:** 11 species including the Fan-tailed Cuckoo, Horsefield's Bronze-Cuckoo, Rufous Whistler, White-winged Triller, Rufous Songlark, White-browed Woodswallow and Olive-backed Oriole in River Red Gums at the census plots on the rear of Rockbank in October 1988

g. Breeding parrots

State. **15^d:** 10 species including the Little Corella, Long-billed Corella, Musk Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Red-rumped Parrot and Blue-winged Parrot in the River Red Gums at the bird census plots on the rear of Rockbank in October 1988

h. Bats

State. **15^a:** 8 species including the Chocolate Wattled Bat, Southern Forest Bat, Inland Broad-nosed Bat and Southern Freetail Bat on 12 November 1988 and 8 species including the Chocolate Wattled Bat, White-striped

Freetail Bat, Southern Freetail Bat and Eastern Freetail Bat on 26 January 1989 (both at a dam in the north-east section of Fenwick Stud)

k. Frogs

Regional. 15^a: 7 species including the Striped Marsh Frog and Peron's Tree Frog in the north-east section of Fenwick Stud on 15 December 1988

Regional. 15^b: 6 species including the Striped Marsh Frog along Darebin Creek at van Roosendael's on 9 December 1988

l. Reptiles

Regional. 15^b: 10 species including the Cunningham's Skink, Bougainville's Skink, Tussock Skink, Large Striped Skink and Lowland Copperhead at the rear of van Roosendael's and Findon Park on 5 October 1988

Regional. 15^a: 8 species including the Cunningham's Skink, Bougainville's Skink, Tussock Skink, Large Striped Skink and Eastern Three-lined Skink at the front of Fenwick on 3 November 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 15^a: 91 species. **15^b:** 90 species. **15^d:** 85 species

b. Native birds

Regional. 15^d: 72 species. **15^b:** 66 species. **15^a:** 55 species

c. Native mammals

Regional. 15^a: 15 species (10 species of bats). **15^b:** 7 species

Local. 15^d: 3 species (no trapping survey)

d. Herpetofauna

Regional. 15^a: 21 species. **15^b:** 17 species. **15^d:** 10 species

f. Butterflies

Local. 15^d: 11 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 15^a: 17 species. **Local. 15^d:** 12 species. **15^b:** 10 species

b. Regionally endangered fauna (R1 species)

Regional. 15^a: 2 species. **Mammals:** Inland Broad-nosed Bat, Southern Freetail Bat

Regional. 15^d: 2 species. **Birds:** Red-chested Button-quail, Masked Owl

Regional. 15^b: 1 species. **Birds:** Brolga

c. Regionally vulnerable fauna (R2 species)

Regional. 15^a: 5 species. **Birds:** Crested Pigeon, Barking Owl, Brown Treecreeper. **Mammals:** Eastern Freetail Bat. **Frogs:** Peron's Tree Frog

Regional. 15^d: 3 species. **Birds:** Crested Pigeon, Barking Owl, Blue-winged Parrot

d. Regionally rare fauna (R3 species)

Regional. 15^a: 4 species. **Birds:** Little Corella, Masked Woodswallow, White-browed Woodswallow. **Reptiles:** Marbled Gecko

Regional. 15^b: 4 species. **Birds:** Australian Spotted Crane, Australasian Shoveler, Hardhead, Little Corella

Regional. 15^d: 2 species. **Birds:** Little Corella, White-browed Woodswallow

Regional. 15^e: 1 species. **Birds:** Australasian Shoveler

e. Regionally depleted fauna (R4 species)

Regional. 15^a: 6 species. **Birds:** Powerful Owl, Australian King-Parrot, Rainbow Bee-eater, Rufous Songlark.

Reptiles: Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

Regional. 15^d: 5 species. **Birds:** Brown Quail, Peregrine Falcon, Powerful Owl, White-winged Triller, Rufous Songlark

Regional. 15^b: 5 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Swamp Harrier, Striated Fieldwren

f. Regionally restricted fauna (R5 species)

Regional. 15^d: 16 species. **Birds:** Australian Shelduck, Little Eagle, Australian Hobby, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brown Songlark, Singing Bushlark. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink. **Frogs:** Common Spadefoot Toad. **Butterflies:** Phigalia Skipper, Meadow Argus, Dark Purple Azure

Regional. 15^a: 11 species. **Birds:** Cattle Egret, Australian Hobby, Barn Owl, Long-billed Corella. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

Regional. 15^b: 8 species. **Birds:** Australian Shelduck, Long-billed Corella. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog

Local. 15^e: 4 species. **Birds:** Australian Shelduck. **Reptiles:** Large Striped Skink, Bougainville's Skink, Tussock Skink

g. Nesting birds of prey/parrots

Regional. 15^d: Little Eagle, Australian Hobby, Barking Owl, Long-billed Corella, Little Corella, Purple-crowned Lorikeet, Little Lorikeet and Blue-winged Parrot in River Red Gums at rear Fenwick/Rockbank in 1988/89

Regional. 15^a: Long-billed Corella in River Red Gums at front Fenwick in 1988

F. POPULATION DENSITY: Viability and Abundance—point census

m. Regionally rare fauna (R3 species)

Regional. 15^a: 8 pair of White-browed and a pair of Masked Woodswallows breeding in River Red Gums in north-east section of Fenwick Stud on 3 November 1988

Regional. 15^b: 6 Hardheads at van Roosendaal's dam on 4 October 1991

o. Regionally restricted fauna (R5 species)

Regional. 15^a: 40 Long-billed Corellas in north-east section of Fenwick Stud on 2 December 1986

Regional. 15^b: 15 Bougainville's Skinks, 25 Large Striped Skinks and 14 Tussock Skinks from a 120-minute herpetofauna search on stony crests at the rear of Findon Park on 5 October 1988

Regional. 15^d: 10 Bougainville's Skinks, 20 Large Striped Skinks and 16 Tussock Skinks from a 120-minute herpetofauna search on stony crests at the rear of Fenwick Stud on 17 October 1988

Outlook

While broad-acre farm management has maintained many biological values and enabled some areas of tree regeneration, the loss of understorey shrubs and general decline of the trees is a concern. The faunal significance will decline as the old trees die unless conservation management outlined in the conservation measures is undertaken. Rocky grassland areas should be protected from clearing, pasture modification and heavy grazing. A system of temporary grazing exclusion plots should be established to enable regeneration/shrub layer planting.

FAUNA

Rare Or Threatened Fauna

Bc **15^d: Red-chested Button-quail.** An extensive block of Kangaroo Grass plains grassland (23.2) at the rear of Fenwick Stud was spelled from grazing in spring 1988. A pair of Red-chested Button-quail was observed on the last day (29 October) of the 1988 bird census. It is likely that they bred. The button-quail requires stands of ungrazed grassland of 20 ha or more. An adjoining property fronting Darebin Creek to the south-west was also ungrazed at the time. In recent years this block has been grazed heavily. Stubble Quail were relatively common in 1988 in the grassland at the rear of Fenwick and the adjoining block to the south-west. Quail were scarce to absent from grazed parts of the site in 1988/89.

Bc **15^b: Brolga.** Single birds or a pair have been seen two or three times in the last decade at freshwater meadows and soaks near dams along the floodplain of the Darebin Creek south-east of Woodstock (Nick van Rosendaal pers. comm.). Habitats include Common Tussock-grass–Rush Sedge seasonal wetland (25.2) and Brown-back Wallaby-grass seasonal wetland (25.3). The creek supports River Red Gum (drainage line) grassy woodland (14.4) while ephemeral tributaries support Common Spike-sedge drainage line herbfield (24.1). The nearest resident Brolga population is on the plains between Skipton and The Grampians in south-western Victoria. Outside the breeding season in late summer–autumn, birds of the western district band into wandering flocks (Emison *et al.* 1987). Vagrants now visit the Plenty Volcanic Plains and Werribee Volcanic Plains west of Melbourne after more than a hundred years absence.

Brolgas dig up tubers of sedges as well as worms and insects (e.g. cockchafer beetle larvae) from moist ground and take insects such as grasshoppers and beetles, small vertebrates such as frogs and lizards and cereal grain, grass seeds and herbage (Blakers *et al.* 1984, Reader's Digest 1986).

Brolgas were breeding residents of the marshy plains of GM for a few decades after settlement (Wheelwright 1862, Batey 1907). They bred in open grassy freshwater marshes, concentrating to the centres of drying swamps and permanent tree-lined lakes and waterholes along creeks by early summer (Wheelwright 1862). Isolated nests consisting of a mound (1.5 m diameter) of coarse grass or sedges and earth are placed, often on a raised hummock, in newly inundated marshland in early spring in the western district. They nest in the same swamp year after year and usually two young are reared.

Their local extinction last century was primarily due to wetland draining (particularly freshwater meadows, shallow freshwater marshes and drainage lines) and cultivation and grazing of these and adjacent grasslands, which caused loss of breeding sites and major vegetable food items (e.g. tubers of Plains Yam-daisy and club-sedges; see also Long-billed Corella).

Other threatening processes induced by European settlement included shooting (for the table), poisoning (in wheat fields), human interference during the breeding season and predation of young by foxes and cats. The species has been less persecuted by humans over recent decades due to hunter education and a raised awareness about habitat and land protection in the community. With active management and adequate protection and provision of suitable feeding and breeding habitat, a range expansion from the population centre of south-western Victoria may occur in GM.

Bc **15^{ad}: Barking Owl.** The stand of mature River Red Gum grassy woodland (14.1) on Fenwick Stud, Rockbank and adjoining properties contains a high diversity of owls (5 species). The Sugar Glider and Common Ringtail Possum, which are important prey, are both present at Fenwick. They were not recorded elsewhere on the Plenty Volcanic Plains. Fenwick and Surrounds and the Plenty Gorge are the only areas in GM where the Powerful Owl, Barking Owl and Masked Owl were each recorded.

A pair of Barking Owls nested in a large trunk hollow in River Red Gum grassy woodland (14.1) north-east of Fenwick homestead in spring 1988. By the time of discovery on 5 October, young were well advanced and both adults were leaving the nest unattended while hunting. The owls had been heard from the homestead over previous months and have been resident for many years (Marshall and Gibson Maclean pers. comm.). One was observed taking a rabbit near the Fenwick/Rockbank boundary rock wall on 27 October. The adult birds with two newly fledged young were last observed north of the Fenwick out stables on the evening of 3 November.

Bc **15^{ad}: Powerful Owl.** It was learned from interviews with residents of Fenwick Stud and Rockbank in spring 1988 that birds have been heard over the years and seen on occasion roosting in large conifers in farm gardens (Marshall Maclean pers. comm.; Gibson Maclean pers. comm.; Arthur Jeffery pers. comm.). Over the following months the site was surveyed as part of the Plenty Growth Corridor studies (Beardsell 1989). Numerous day and several evening visits were made to Fenwick Stud and Rockbank in spring–early summer 1988, late in the breeding season of the Powerful Owl. The species was not recorded until late February 1989 (see below). This does not prove they were absent in the breeding season, as more often than not birds are quiet in the early evening and call in the early morning. From survey experience with the Powerful Owl (and Barking Owl and Masked Owl), unless specific searches are made or information comes to hand from residents, adult breeding sites are seldom located.

Two birds presumed to be adults were calling from River Red Gum grassy woodland (14.1) at the rear of Rockbank and Fenwick Stud on 24 February 1989. The presence of an adult pair suggests it is possible the Powerful Owl breeds locally. The large River Red Gums of the site are suitable, provided adequate prey is present (the most likely being small Common Brushtail Possums and Common Ringtail Possums; see site 83). It is equally possible the site lies within the home range of Powerful Owls that nest in the Plenty River headwaters. The home range of a breeding pair can be 3–4000 ha (Rod Cavanagh pers. comm.). Under this scenario, the woodland provides lowland summer feeding grounds for the adults (breeding March to December) and autumn–winter dispersal grounds for their young. Breeding or visiting, the site is important for them in either event.

Bc **15^d: Masked Owl.** One responded to a playback tape of the species call from River Red Gum grassy woodland (14.1) at the rear of Fenwick Stud on 19 October 1991. The bird was seen briefly from a distance and appeared to be an adult male. With the availability of extensive hollows in the River Red Gums it is likely the owl bred locally. They have declined in the foothills, where timber harvesting has depleted the mature trees (see site 75). On this basis, the grassy woodland stand on Fenwick/Rockbank may be one of the most important habitats for the Masked Owl in NEM.

Home ranges of the Masked Owl are of the order of 1–2000 ha. Birds become locally nomadic in areas and seasons of low prey productivity (see site 75). The Fenwick site provides one of the most intact stands of mature River Red Gum grassy woodland in Victoria. It is one of few remaining in association with moderately intact native grassland and patches of native shrubland. Historically, the Masked Owl inhabited grassy woodland in western Victoria (e.g. Casterton) but in recent decades there have been no records. Tree decline, understorey clearing and grazing and loss of native prey have eliminated the owl from intensively farmed sections of the volcanic plains of south-western Victoria.

With the natural absence of extensive tree cover over a large portion of the plains, Masked Owls inhabited rugged river gorges (e.g. caves in the Werribee River) and craggy mountain peaks (e.g. caves in the You Yangs). On the timbered sections of the plains north of Melbourne they appear to be restricted to areas containing native grassland. This persists mainly in the stony rise country such as Fenwick Stud and Rockbank. The owl takes prey from trees and the ground. Prey may often be seasonally abundant or scarce so the diet is varied. On the grassy woodland plains at Fenwick/Rockbank, ground prey would include rabbits and quail, while arboreal prey would include possums, parrots and bats. Stone wall fences are particularly important as they harbour rabbits.

Retention of old woodland trees and their replacement through regeneration and replanting habitat links is required for long-term conservation of the Masked Owl. Maintaining prey abundances through habitat link enhancement, regeneration of shrub layers and protection of grassland areas and continued provision of River Red Gum nest-hollows will be critical for their survival.

Critical Assemblages or Populations

- Cg* **15^d: High diversity of nesting parrots at Rockbank.** Ten species of parrots were recorded breeding in River Red Gum hollows at the rear of Rockbank during the bird census of 24–29 October 1988. These included the Musk Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Blue-winged Parrot, Little Corella, Long-billed Corella and Red-rumped Parrot.
- Ch* **15^a: High diversity of bats at Fenwick Stud.** The trapping site was a dam under River Red Gum grassy woodland (14.1) in the north-east section of Fenwick Stud. Eight species were recorded on two occasions. These included the White-striped Freetail Bat, Southern Freetail Bat, Eastern Freetail Bat and Chocolate Wattled Bat on 26 January 1989 and the Southern Freetail Bat and Chocolate Wattled Bat and two additional species (Inland Broad-nosed Bat and Southern Forest Bat) on 26 January 1989. Ten species overall were taken at the trapsite. Along with the north-eastern corner of Radar Hill at Melbourne Airport in WM (Beardsell in prep.), this is the highest diversity of bats caught at a woodland trapsite in GM.

Other Significant Fauna

Birds

- Ec* **15^{ad}: Crested Pigeon.** Recorded on several occasions in River Red Gum grassy woodland (14.1) during the study (e.g. north-east section of Fenwick on 26 January 1989 and nesting at Rockbank on 24 October 1989). In a response to pastoral occupation similar to that of the Little Corella, the pigeon has expanded its range from inland Australia. They appear to be colonising the Plenty Volcanic Plains and nearby alluvial plains at Glenvale (sites 36/37). This has been favoured by the availability of nesting sites in paddock Hawthorns and ample food in the form of pasture weeds such as Patterson's Curse and loose grain around farmyards.
- Ec* **15^a: Brown Treecreeper.** Two to three birds were recorded in River Red Gum grassy woodland (14.1) in the north-eastern section of Fenwick on 2 December 1986 and 26 January 1989. They were absent during the October bird census of 1988/89. This is the last group remaining on the volcanic plains of NEM. They apparently disperse west along the Strategic Habitat Link onto the plains from Yan Yean Reservoir after the breeding season.
- Ec* **15^d: Blue-winged Parrot.** They are rare in NEM during spring–summer. Only two breeding observations were made. One of these was a pair in a broken branch spout at the rear of Rockbank in River Red Gum grassy woodland during the 25–29 October 1988 bird census. The other observation was of a pair in Mealy Stringybark heathy woodland at the foot of Mt Disappointment (site 98) in October 1987.

The species is normally observed in autumn passage in NEM, as pairs or small flocks on migration from breeding grounds in Tasmania and damp coastal and upland forests of Victoria. They are less frequently seen on their return trip in October. Many move into open, dry grassland and low shrubland habitats in the interior of Australia. Small nomadic flocks, particularly in drought years, overwinter in dry, open woodland and grassland in the Plenty and Merri Valleys (e.g. site 12 near Craigieburn Grassland in June 1991).

In the grasslands they take seeds and herbage of field layer grasses and herbs, particularly introduced composites such as Ox-tongue, Garden Dandelion, Cat's-ear and thistles and the Prostrate Knotweed. In the ranges where they breed, the seeds of groundsels, Forest Wire-grass and raspworts along track margins and in clearings are important. They use their claws to pull down the seed heads of tall thistles. Some insects are also taken (Blakers *et al.* 1984).

The species would have formerly been more common on the plains of NEM but has been reduced by clearing of grassy woodlands, loss of nest-hollows and the replacement of native grasslands and shrublands with alienated pastures.

- Ed* **15^b: Australian Spotted Crake, Hardhead and Australasian Shoveler at van Roosendaal's dam in the Darebin Creek.** Twenty four-species of waterbirds including eleven species of waterfowl were recorded in the Common Reed–Cumbungi emergent herbfield (25.7) and permanent wetland of the open water (26.1) along the Darebin Creek at van Roosendaal's dam on 4 October 1991. Seven species of waterfowl were breeding. These included the Eurasian Coot, Australasian Grebe, Black Swan, Australasian Shoveler, Grey Teal and Chestnut Teal. Significant waterbirds included the Brown Quail (see *Ee*), Australian Spotted Crake,

Latham's Snipe (see *Ee*), Australian Shelduck (*Ef*), Hardhead, Australasian Shoveler and Swamp Harrier (see *Ee*).

Ed **15^{abd}: Little Corella and the impact of land settlement.** This is an inland Australia species that has undergone a southward range expansion due to forest clearing and pastoral settlement. It was first recorded in Victoria around 1950 and in GM, near Yan Yean after the inland drought of 1977. This range expansion has corresponded with the pastoral conversion of tall native grasslands to lower alien grazing lands. Double-barred Finches and Crested Pigeons appear to have benefited in the same way in northern Victoria. Expansion has been greatly assisted by the availability of cereal grain and seeds of pasture weeds and free water provided by dams and bores in previously dry areas. The species range now overlaps that of most of the Long-billed Corella and instances of cross breeding have been observed at Yan Yean and Fenwick.

The diet of the Little Corella is more varied than the Long-billed Corella. They take a higher proportion from above ground. This includes shoots and surface seeds of cereal grain (e.g. livestock feed trails), legumes, thistles and Prostrate Knotweed. Like the Long-billed Corella, Galah and Sulphur-crested Cockatoo, they take the underground corms of Common Onion-grass in winter and spring when the ground is soft. Similar to the Sulphur-crested Cockatoo, they freely climb around shrubs in search of fruit.

The main breeding population (about 200 birds) in NEM of the Little Corella is resident on the Plenty River and Barbers Creek floodplain between Mernda and Woodstock. Frequent nesting observations were made in River Red Gum upper trunk hollows during the bird census of October 1988 and 1989. Pairs nest in the same hollows through their breeding life. From November to July, birds disperse from their breeding sites into the surrounding foothills. Ripening wattle seed is important in late spring–early summer while fruit of the Hawthorn and Sweet Briar are important in late summer–autumn. The range expansion has continued over the last decade. Little Corellas are now breeding in Manna Gums along the Plenty River, Arthurs Creek, Diamond Creek, Scrubby Creek near Humevale, Steels Creek and the Yarra River at Yering.

Ed **15^a: Masked and White-browed Woodswallow.** The woodswallows arrived in the north-east section of Fenwick Stud on the last day of the bird census, 29 October 1988. Eight pair of White-browed and a pair of Masked Woodswallows were nesting in the River Red Gum grassy woodland (14.1) when visited on 3 November 1988. The woodswallows formed a non-communal nesting colony. The area contained a dense stand of 20-year-old sapling River Red Gums. The nests of both species consisted of a rough bowl of twigs placed in the sapling branch-forks, 2–4 m above ground. Several of the White-browed Woodswallows also built nests in large hollow spouts of a nearby veteran River Red Gum.

Most of the feeding time of the woodswallows was spent on insect hawking over the tree canopies, though insects (particularly psyllids) and their exudates were also being gleaned from the River Red Gum foliage. In a subsequent visit on 2 December 1988, the River Red Gums were flowering. The woodswallows and their newly fledged young were engaged in hawking bees and beetles attracted to the blossom and also occasionally fed on the blossom nectar. The River Red Gums flower in unison about once in five years. It was possible that the woodswallows had perceived that the eucalypts were going to flower when they chose to nest a month earlier. When the site was revisited on 15 December 1988, they had departed.

The woodswallows did not visit Fenwick Stud in 1989. They are spring–summer migrants from inland Australia arriving from mid to late October. The White-browed visits about every second year while the Masked Woodswallow comes with them once every three to five years. At intervals of about ten years, large irruptions enter southern Victoria and flocks of hundreds of birds pass over for several days. Conditions of drought after preceding wet (bountiful) years in the inland lead to this coastal exodus. White-browed Woodswallows usually outnumber Masked Woodswallows by about 10 to 1.

Loss of tall shrubs (acacias) and low trees (Drooping Sheoke and Tree Banksia) and lack of regeneration and tree decline of River Red Gums in rural areas due to clearing and grazing has reduced the nesting frequency of woodswallows. Decline of native prey (e.g. midges and native bees) due to canopy loss, grassland degradation and chemical poisoning is a likely threat.

- Ee* **15^d: Brown Quail.** Several males were calling at dusk from seasonally inundated paddocks east of Rockbank homestead after wet weather on 6 December 1988. Prior to cultivation, the swamp would have supported Common Tussock-grass–Rush Sedge seasonal wetland (25.2).
- Ee* **15^b: Buff-banded Rail, Latham’s Snipe and Swamp Harrier.** The rail and snipe were recorded in Common Reed–Cumbungi emergent herbfield (25.7) fringing van Roosendael’s dam along Darebin Creek. The rail was observed on 5 October 1988. A single snipe was flushed on 4 October 1991. Up to a half dozen snipe have been recorded (Nick van Roosendael pers. comm.). Both species are restricted on the volcanic plains to watercourses and swamps. The ungrazed freshwater meadows fringing the dam are important for cover-dependent birds as little of this habitat remains on the volcanic plains. A Swamp Harrier was seen in seasonally flooded grassland near the creek upstream of the dam on 4 October 1991. This area supports remnant River Red Gum (drainage line) grassy woodland (14.4).
- Ee* **15^a: Australian King-Parrot and other visiting parrots during autumn–winter.** With its geographic location at the foot of the Great Dividing Range, the grassy woodland contains an unusual overlap of mountain parrots. These include the Gang-gang Cockatoo, Australian King-Parrot and Crimson Rosella. Each of these species was recorded between late summer and late winter.
- Ee* **15^b: Striated Fieldwren and other locally scarce grassland passerines along the Darebin Creek.** The creek supports remnant River Red Gum (drainage line) grassy woodland (14.4). The fieldwren and White-fronted Chat (breeding) were seen in seasonally flooded grassland near van Roosendael’s dam on 5 October 1988.
- Ef* **15^{abd}: Long-billed Corella and the impact of land settlement.** Changing fortunes of corellas over the 150 years of land settlement provide one of the more intriguing accounts of this study. Field research on corellas conducted in 1988 and 1989 at this site was part of a statewide Fisheries and Wildlife (NRE) research study led by Bill Emison of the Arthur Rylah Institute. It was found that a select few locations of River Red Gum grassy woodland in Victoria (Fenwick and Surrounds being one) provided an ‘ark’ for the Long-billed Corella to survive the middle era of land settlement. Several other grassy woodland animals failed in southern Victoria. These include the Southern Bush-curlew, Grey-crowned Babbler, Eastern Quoll and Eastern Banded Bandicoot (documented elsewhere in this report).

Management of Fenwick Stud has been buffered from intensive land-use practices of the modern era. It has been run primarily for horses and has not been overstocked. The rocky grasslands remain intact and regeneration of River Red Gums has been able to occur (see Conservation Measures). Through the middle era, several adjoining properties also supported these attributes. The ‘ark’ provided for Long-billed Corellas was two-fold: the availability of native geophytes as a winter–spring food source and protection of mature River Red Gums and their nesting hollows. These are both reasons for the Fenwick and Surrounds site being the River Red Gum Critical Conservation Area in NEM.

In Victoria the Long-billed Corella primarily inhabits River Red Gum watercourses and plains in association with pasture, grassland and cereal crops. The most substantial population in GM (over 500) occurs between Woodstock and Yan Yean. Smaller concentrations (totalling 400–500 birds) are found in the Yarra Valley between Plenty River and Diamond Creek, River Red Gum sections of the Merri Plains around Donnybrook, Plenty Gorge and lower Arthurs Creek and middle Diamond Creek. Adults stay within a large home range (up to 1000 ha), while juveniles become locally mobile over the plains and foothills during autumn–winter. At this time of year flocks of upwards of 200 birds form on the Barbers Creek floodplain. These often mix with Sulphur-crested Cockatoos, Galahs and Little Corellas at favoured food sources (e.g. germinating oat crops) and roosting sites.

Nesting habitats of the Long-billed Corella are provided in River Red Gum grassy woodland (14.1/14.4) on the volcanic plain and drainage lines of Barbers Creek and River Red Gum (alluvial plain) grassy woodland (14.3) on the floodplain of the Plenty River (sites 38/39). Breeding pairs occur throughout the adult range, nesting in trunk hollows and spouts of River Red Gums. Pairs use the same hollow over successive years, breeding in spring. Usually two young are reared. As with most parrots, nest sites are usually close to water along creeks and at dams. In the non-breeding season birds usually roost near water.

From late autumn to early summer, while the ground is soft, Long-billed Corellas dig for most of their food. In the Plenty Volcanic Plains they have been most frequently observed on the corms of the widespread pastoral weed, Common Onion-grass. Native geophytes (plants with underground storage organs) including lilies and orchids and the turnip-like taproots of Grassland Crane's-bill are also eaten. These plants remain in uncultivated areas of Kangaroo Grass stony knoll grassland (22.2), Kangaroo Grass plains grassland (23.2) and Brown-back Wallaby-grass (gilgai/swale) seasonal wetland (25.3) at Fenwick and Surrounds.

Underground pasture insect larvae are fed to nestlings during spring. The roots and tubers of sedges and Water-ribbons along local creeks are important in summer. Surface seeds carry birds over the food shortage of summer and autumn. These include the native Grassland Crane's-bill and introduced Cat's Ear, Garden Dandelion, heron's-bills and Prostrate Knotweed and spilled oats from livestock feed-trails and food troughs.

Land-use within grassy woodland ecosystems of the Plenty Volcanic Plains falls into three eras since settlement. The early era (1840 to 1900), middle era (1900 to 1950) and recent era (1950 to present). The early era was associated with extensive and rapid floristic and structural changes in grassy woodland with the onset of intensive tree clearing and livestock grazing, predominantly sheep. Tree clearing slowed and livestock grazing intensity was unchanged through the middle era, but the effect of rabbits on vegetation and foxes on faunal populations was at its most severe. Faunal extinctions were high, several finally succumbing after long-term decline from the early era. With the recent era came the advent of intensive land use practices including mechanised earthmoving machinery to remove rocks and superphosphate to promote pastures. This enabled cattle to overtake sheep as the main local livestock industry. These factors along with modern subdivision pressures caused the grassy woodland (both trees and grassland) to go into substantial decline.

Extremely abundant at the time of settlement, the range of the Long-billed Corella occupied much of the lowland woodland plains of south-eastern Australia. They rapidly became rare and were considered extinct over most of this range by the end of the early land-use era (1900). Livestock grazing had eliminated their native foods, particularly the underground tubers of grassland and freshwater meadow herbs such as the Plains Yam-daisy. There was also widespread shooting and poisoning by farmers due to damage to cereal crops. Interviews with long-term residents revealed that the Long-billed Corella survived the middle land-use era (1900–1950) on the red gum plains between Woodstock and Yan Yean. This was because native foods persisted in uncultivated, broad-acre rocky grasslands and tree hollows were available for nesting.

With little cereal being grown, the corella seldom came into conflict with graziers in NEM. Unlike other parts of its range in Victoria where cereal is more widely grown, it survived without a dependence on grain. Nor was the bird persecuted so heavily. Over the last 20 years the Long-billed Corella has again become locally common, recovering two-thirds of its former Victorian range. This is due to a switch in food preference to Common Onion-grass. However, seasonal shifts onto cereal and oilseed crops bring the species into conflict with growers in western Victoria. Loss of nest hollows due to rural tree clearing and dieback will prevent the Long-billed Corella from re-establishing their original numbers on the plains and may lead to a decline in the long-term. This may be offset by partially cleared foothill forest habitat which has become available.

The Long-billed Corella serves as an important lesson. It shows that at least some native species, which may well have been heading to extinction, were able to adapt and survive the rigours of land settlement. This offers hope that endangered species such as the Regent Honeyeater and Southern Lined Earless Dragon may have a similar survival mechanism. But is totally dependent on adequate protection of viable habitat areas where these species occur. This is the primary objective in identifying the series of Critical Conservation Areas and Ecological Reference Areas in NEM.

Ef **15^d: Brown Songlark and Singing Bushlark.** Both were recorded in an extensive block of ungrazed Kangaroo Grass plains grassland (23.2) at the rear of Fenwick Stud (see Red-chested Button-quail; *Bc*) during both years of the October 1988/89 bird census. They were not recorded in grazing land elsewhere in the site.

Plenty Valley River Red Gum bird census (see Volume 1).

Mammals

Eb **15^a: Southern Freetail Bat at Fenwick Stud.** Males were taken by triplining (fishing line strung over a dam) in the north-east section on 12 November 1988 and 26 January 1989. The habitat and fauna of River Red

Gum grassy woodland (14.1) in the Plenty/Merri Plains have affinities with the semi-arid zone of inland Victoria. Trapping the Southern Freetail Bat (*Mormopterus planiceps* 'long penis' form) and Inland Broad-nosed Bat (see **Eb**) at Fenwick Stud highlights this link. Both, prior to this study, were considered inland species not known to occur in GM.

The Southern Freetail Bat is widespread across northern Victoria ranging in habitats from River Red Gum riverine forest and grassy woodland, box–ironbark woodland to mallee shrubland. It is restricted to volcanic plain grassy woodland in GM, where it is locally more common than the Eastern Freetail Bat (see **Ec**). Each of the five trapping sites of the Southern Freetail Bat was away from streams. Two of these were in Western Melbourne (Mount Ridley and Radar Hill) and two were in NEM (Craigieburn Road East in site 13 and Silver Gum Park near Woodstock in site 17). Fenwick was the only capture site of both the Southern Freetail Bat and Eastern Freetail Bat.

The Southern Freetail Bat roosts and breeds in colonies in tree hollows and occasionally in building roofs (Menkhorst 1995). Mating occurs in autumn and winter. After a period of sperm storage and possibly delayed implantation a single young is born in summer (Menkhorst 1995).

The Southern Freetail Bat drinks regularly and is most often trapped over open water. It has long narrow wings, indicating a fast and direct flight pattern and capability for relatively long-distance dispersal. They typically fly over the tree canopy like the White-striped Freetail Bat, hawking for nocturnal flying insects. Prey are usually small and include bugs (e.g. the pastoral pest, Rutherglen Bug), moths, beetles, bees/wasps and flies/mosquitoes (Menkhorst 1995).

The Southern Freetail Bat is also an agile climber. One released onto River Red Gum foliage at Fenwick Stud was observed gleaning psyllid insects after removing their shells (lerp). The species may be a dieback control agent of psyllid defoliated River Red Gums. Southern Freetail Bats are able to scurry efficiently over the ground, so ground invertebrates (e.g. ants) may occasionally be taken. Being flat, the freetail bat can crawl under loose bark, which may explain cockroaches found in stomach content analyses.

Analysis of all trapping records of the Southern Freetail Bat and Eastern Freetail Bat in GM, reveals males to outnumber females by about 4 to 1. Observations at roosts elsewhere suggest the sexes to be of equal number. The capture disparity indicates there may be feeding niche specialisation amongst the sexes. Females may be more predominantly foliage insect and exudate gleaners or nectar-feeders (for instance, in the nest-tree while breeding). Their diet may make them less dependent on water and may account for their lower trapping rate.

Eb 15^a: Inland Broad-nosed Bat at Fenwick Stud. Individuals were triplined under River Red Gum grassy woodland (14.1) at dams in the north-east section of Fenwick Stud on 12 November and 15 December 1988. The species is widespread in northern Victoria but is recorded infrequently and at very low capture rates. Areas include River Red Gum riverine plains of the Middle Murray (e.g. Barmah) and its tributaries, River Red Gum–Grey Box grassy woodlands and box–ironbark woodlands of north-central and western Victoria and mallee shrublands of the arid north-west (Menkhorst 1995). Given the threatened conservation status attached to most of these habitats, it is not inconceivable that the Victorian conservation status of the Inland Broad-nosed Bat should be considered as Rare.

The Inland Broad-nosed Bat is a very rare associate of swamps and streams in the lower rainfall River Red Gum (volcanic plain) grassy woodland (14.1) and riparian scrub (18.2) along volcanic watercourses to the west and north of Melbourne. It was also trapped in Grey Box grassy woodland (14.8) in two localities west of Melbourne. The bat was trapped at eight localities in GM. Two of these were on the volcanic plains of NEM (site 4 and this site). Fenwick is the only locality where more than one capture occurred.

There are no breeding records of the Inland Broad-nosed Bat in GM. The breeding behaviour is little studied. Anecdotal information has been reviewed by Menkhorst (1995). They are known to roost and breed in hollows of trees and buildings and the females form maternity colonies. Births are in spring (usually 1 to 2) with young flying at five weeks. Females lactate until mid-summer, indicating young remain dependent until this time. Inland Broad-nosed Bats have been reported roosting in very confined spaces (e.g. metal caps under telegraph poles), partly explaining the apparent low population densities.

Inland Broad-nosed Bats consume a wide array of beetles, bugs, bees/wasps, flies/mosquitoes and moths, mostly taken by hawking after slow aerial pursuit (Menkhorst 1995). Prey such as beetles are often of larger size than those taken by other similar-sized bats such as the Large Forest Bat, Southern Freetail Bat and Chocolate Wattle Bat. Most individuals trapped in GM were from over water, shortly after dusk on hot mid-summer nights. The related Eastern Broad-nosed Bat has been observed along the Plenty River hawking before dark amongst mating-swarms of mosquitoes, mayflies and midges. The relationship with water suggests that the Inland Broad-nosed Bat would feed in a similar manner. Analysis of faecal samples has also found wingless ants, which suggests they may take food from the ground or foliage.

The Plenty Valley provides the nearest known approach of the Inland Broad-nosed Bat of northern Victoria and the Eastern Broad-nosed Bat of eastern Victoria. The two species are delineated in range according to rainfall and habitat. The eastern species occurs along the Plenty River, Yarra River and lower Diamond Creek in higher rainfall riparian forests, floodplain riparian woodlands and alluvial plain grassy woodlands. It has also been recorded in the Upper Yarra at Corranderk and south-east of Melbourne at Braeside Park, but not west of Melbourne or in north-western Victoria.

Ec **15^a: Eastern Freetail Bat at Fenwick Stud.** Males were trapped in River Red Gum grassy woodland (14.1) at a dam in the north-east section of Fenwick Stud on 26 January 1989. One was taken in a mist-net and another was triplined. The genus *Mormopterus* is undergoing taxonomic revision. Two 'short penis' species determined from electrophoretic analysis are known to occur in Victoria (Lindy Lumsden pers. comm.). These are widely separated in range and habitat (arid north-west and eastern Victoria) but cannot be separated on external morphological features. Identification of these species can be determined from morphometric analysis of the central bone at the base of the penis (bacculum). The eastern species was first recorded in the early 1980s in coastal forest habitats of East Gippsland. It has since been confirmed in north-eastern and central Victoria (the latter from Corranderk in the Upper Yarra region of GM and Puckapunyal).

Electrophoretic analysis has not been run on animals trapped in NEM. The location of the Plenty Volcanic Plains is midway between Corranderk and Puckapunyal. On the basis of geographic distribution, animals caught at Fenwick have been tentatively classified as the East Gippsland–Corranderk–Puckapunyal species, referred to in this study as the Eastern Freetail Bat. This species occurs in association with River Red Gums or Manna Gums along streams and at swamps, with about a dozen records in GM.

To the west of Melbourne the Eastern Freetail Bat has been trapped between the You Yangs and Bacchus Marsh. Most records in NEM were near streams, particularly Yarra River and adjoining sections of Plenty River and Diamond Creek. Habitats included drainage line grassy woodland (e.g. Gresswell Forest), floodplain riparian woodland (e.g. Yallambie) or riparian forest (e.g. Eltham North). Despite extensive trapping, the Fenwick captures were the only made away from a stream or swamp in GM.

Reptiles

CI/Fo **15^{abd}: Volcanic plains reptiles.** Extensive reptile survey including timed searches and pitfall trapping was conducted in the site. Twelve volcanic plains grassland species were recorded, nine of these on the stony knolls while another three were confined to the creeks. Areas surveyed included the north-east section of Fenwick Stud (**15^a**), Darebin Creek including van Roosendaal's and Findon Park (**15^b**) and the southern section of Fenwick Stud and adjoining northern section of Rockbank (**15^d**). Habitats included River Red Gum (volcanic plain) grassy woodland (14.1; **15^{abd}**), River Red Gum (drainage line) grassy woodland (14.4; **15^b**), Kangaroo Grass stony knoll grassland (22.1; **15^{abd}**) and Kangaroo Grass plains grassland (23.2; **15^{abd}**). Plains grassland was also the understorey to grassy woodland and was only differentiated when the trees were absent.

A pitfall line of ten traps was set on a stony crest along a rock wall in the south section of Fenwick Stud (**15^d**) from 20 October to 13 November 1988. Results were unproductive compared with the active herpetofauna searches. Only single animals of four reptile species were recorded (Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink). It was discovered toward the end of study that a very large Eastern Brown Snake (2 m plus) was taking the lizards, and probably other species such as Little Whip Snakes, from the pitfall traps.

The trap site was chosen as it supported potential habitat for the endangered Southern Lined Earless Dragon and vulnerable Striped Legless Lizard. Neither were taken. Information later came to hand that the dragon is not normally trapped in conventional 'large bucket' pitfall lines (Peter Robertson pers. comm.). Pitfalls of 10 cm wide and 30 cm deep PVP pipe concealed by lids (fitted like a combustion stove flume lid) have proved effective for the capture of animals at Canberra. It was also later learned from studies west of Melbourne that the legless lizard is seldom taken in pitfall traps during spring (Coulson 1990). This author considers that one or both the earless dragon and legless lizard may be present. Fenwick has less disturbed habitat and more natural grazing regime while Findon Park and adjoining properties support extensive habitat. Specific survey is required. This should employ appropriate traps open from mid to late summer.

Active herpetofauna surveys involving searching under rocks were conducted in the north-east section of Fenwick Stud on 3 November 1988 (**15^a**; 1 hour), south-east corner of Findon Park and adjoining corners of Fenwick Stud and Gilghi on 5 October 1988 (**15^b**; 2 hours) and at the rear of Fenwick Stud on 17 October 1988 (**15^d**; 1 hour) and rear of Rockbank on 27 October 1988 (**15^d**; 1 hour). The Large Striped Skink, Bougainville's Skink and Tussock Skink were abundant on stony knolls, particularly when adjacent to rock walls. The Cunningham's Skink, Common Blue-tongued Lizard, Little Whip Snake and Eastern Brown Snake were also recorded at the stony knoll/rock walls, but were locally uncommon. .

Survey Results:

15^a: eight species including 1 Cunningham's Skink, 1 Common Blue-tongued Lizard, 4 Large Striped Skinks, 2 Bougainville's Skinks, 4 Tussock Skinks, 1 Eastern Three-lined Skink, 1 Little Whip Snake and 1 Eastern Brown Snake.

15^b: ten species including 1 Cunningham's Skink, 2 Common Blue-tongued Lizards, 25 Large Striped Skinks, 15 Bougainville's Skinks, 14 Tussock Skinks, 1 Little Whip Snake, 1 Tiger Snake, 2 Eastern Brown Snakes and 1 Lowland Copperhead. The Tiger Snake and Lowland Copperhead were recorded along the Darebin Creek.

15^d (Rockbank): seven species including 1 Cunningham's Skink, 1 Common Blue-tongued Lizard, 3 Large Striped Skinks, 4 Bougainville's Skinks, 1 Tussock Skink, 1 Eastern Three-lined Skink and 1 Eastern Brown Snake. Low stony crests and rock walls were searched amongst River Red Gum grassy woodland. The area was grazed by cattle and sheep and the grassland was low cover wallaby-grass grazing land. This accounted for the low abundance of grassland skinks. The three-lined skink was recorded under a log in 14.1.

15^d (Fenwick): six species including 1 Cunningham's Skink, 3 Common Blue-tongued Lizards, 20 Large Striped Skinks, 10 Bougainville's Skinks, 16 Tussock Skinks and 1 Eastern Brown Snake.

Ed **15^a: Marbled Gecko.** One was foraging under bark on the bole of a River Red Gum (grassy woodland; 14.1) at a dam on the north-east section of Fenwick Stud on 12 November 1988. The observation was made while triplining for bats at the dam. The Marbled Gecko and the majority of the family to which it belongs has a predominantly inland Australian distribution (Eyrean). This, along with grassy woodland, extends into GM through the Kilmore Gap in the Great Dividing Range

The main occurrence of the gecko in GM is the volcanic plains, where they are thinly distributed. Most records have been in basalt stream cliffs (sites 8 and 10) with occasional sightings in rock walls (site 13) and under bark of River Red Gums and Manna Gums (this site and 42). They also occur at granitic outcrops (sites 20 and 98). Populations are well established in older suburbs (e.g. Northcote and Alphington) of Melbourne. Some of these would be derived from natural occurrences while others may have been brought in with firewood.

Marbled Geckos are slow moving and predominantly nocturnal. Adhesive toe pads enable them to climb smooth vertical rock or tree surfaces. They are flat and strongly built and able to crawl into narrow crevices in rocks or under bark. Here they prey on soft-bodied invertebrates such as termites (in rotting wood), ants, moth and beetle larvae and spiders. They employ a wait and pounce method for more active invertebrates such as moths and have also been recorded feeding on plant exudates.

Because of their thin skin, geckos avoid direct sunlight during the day. They are capable of activity at low temperatures even in winter. This frees them from diurnal predators and prey competition with other lizards. In early summer Marbled Geckos deposit two hard-shelled eggs in dry situations behind bark, in rock crevices or under logs or flat stones.

Ee **15^a: Red-bellied Black Snake.** Occasionally observed in Common Spike-sedge drainage line herbfield (24.1) along a tributary of the Barbers Creek at the rear of Fenwick homestead (Marshall Maclean pers. comm.).

Frogs

Ec **15^a: Peron's Tree Frog.** They were recorded while triplining/mist netting for bats at a dam in the north-east section of Fenwick Stud on 15 December 1988 and 26 January 1989. The dam contains a fringe of Common Spike-sedge but livestock grazing restricts the development of emergent herbfield (25.7). The surrounding area supports River Red Gum (volcanic plain) grassy woodland (14.1) and Kangaroo Grass plains grassland (23.2). The main distribution of the frog in NEM is associated with River Red Gum grassy woodland (volcanic and alluvial) and Swamp Paperbark swamp scrub along the Yarra River, with localised occurrences on the Plenty River and Diamond Creek. It is a distinctive arboreal species of timbered, permanent floodplain swamps, billabongs and dams containing tall damp grass or sedge cover.

Active during the warmer months, the breeding season is from October to January. Its start is synchronised with rain and warm nights. Breeding activity (measured by rate of calling males) peaks on warm, sultry nights in December. On these occasions males chorus from trees, emergent reeds or floating vegetation. By day they take refuge under bark or in hollow limbs of River Red Gums by the water edge. A dense egg-mass was located in shallow water at the dam on Fenwick. It was attached to the base of Common Spike-sedge. Development from fertilisation to metamorphosis (mid-autumn) is fairly rapid, taking about six months.

The large, active tadpoles live amongst emergent herbfield in shallow water. Adults take flies, emerging damselfly nymphs and moths from the stems of aquatic plants. Some bark foraging for beetles and spiders on the River Red Gums and log foraging for freshwater shrimps and slaters was observed at Dunnetts Road Swamp, Yan Yean (site 38). Being capable swimmers, they also take substrate invertebrates such as damselfly and mayfly larvae. They also feed in saturated grasslands on wet nights.

Peron's Tree Frogs are dependent on free water, emergent herbfield vegetation and standing trees during the breeding season. Formerly more widespread in the grassy woodland/marshland of the Plenty Volcanic and Alluvial Plains, they have been depleted and fragmented in range by clearing, draining and grazing of marshland.

Ef **15^{ad}: Common Spadefoot Toad.** The toads are widespread in the natural Kangaroo Grass stony knoll grassland (22.1), Kangaroo Grass plains grassland (23.2) and Brown-back Wallaby-grass (gilgai/swale) seasonal wetland (25.3) at Fenwick and Surrounds. Adults were recorded on four occasions in a pitfall line of ten traps set on a stony crest along a rock wall (22.1) in the south section of Fenwick Stud from 20 October to 13 November 1988. Each pitfall capture was after rain had fallen in the previous 24 hours. Several were calling along with a single Bibron's Toadlet (*Ee*) from plains grassland (23.2) at the Donnybrook Road frontage of Fenwick Stud on the rainy night of 2 June 1990.

Common Spadefoot Toads belong to an inland group which has several adaptations to arid environments (see site 5). During periods of inactivity they occupy deep (10–15 cm), sealed burrows in friable soils, often beneath rocks on stony crests. They can maintain the water content of their bodies for extensive periods while underground and are apparently long-lived. After rain they become surface active to feed and breed in the saturated grasslands.

Common Spadefoot Toads breed in dams, drainage lines and temporary pools in deeper gilgais. The breeding season is normally from March to May. Males call from late summer for two or three days after heavy rain episodes. Chained strands of eggs are wound to submerged parts of sedges in standing water. Adapted to temporary pools of inland Australia, larval development is fairly rapid (six months) and metamorphosis occurs in mid-spring. Later tadpole stages are large and contain robust jaws. They consume plant material and possibly small invertebrates. Adults actively hunt moths, small crickets and grasshoppers over the open ground on rainy nights.

Although still widespread, the habitat specificity of the Common Spadefoot Toad may limit its tolerance to environmental change (Turner 1986). They are scarce on many of the intensive farms of the district having lost feeding areas in saturated grassland to clearing (pasture conversion of grassland), draining and grazing and breeding areas on stony knolls to rock clearing. Continuous grazing and trampling reduces (marshland)

vegetation cover essential for egg and larval development and invertebrate food supplies and alters the structure of (grassland) top soil, making it more compact and impervious for adults to dig (Turner 1986).

Butterflies

15^d. Rear Fenwick/Rockbank. Eleven resident breeding species were recorded. Significant species included the Dark Purple Azure (larvae on Creeping Mistletoe on a River Red Gum at the rear of Rockbank in November 1988), Phigalia Skipper (adult at the rear of Fenwick in November 1988; a pupa had been located on Wattle Mat-lily in October) and Meadow Argus (adults flying at Fenwick in November 1988). Irruptions of several inland vagrants were seen in late spring and summer 1988/89. These included the Caper White, Lesser Wanderer, Wanderer and Small Grass Yellow.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. Intact habitat links to the Mernda to Yan Yean site, Epping to Wollert site and Summerhill Road site. Partial link to the Silver Gum Park site and Plenty River Mernda site.</p>	
<p>Plenty–Merri River Red Gum Protection Zone—significant habitat protection. (see Appendix 2.2 and also volume 1)</p>	
<p>Increasing rates of leaf defoliation and tree dieback. Of particular concern in all sites containing River Red Gums in GM is that sustained insect attack causing leaf defoliation and tree dieback is becoming increasingly more prevalent. Habitat fragmentation due to clearing, in association with habitat degradation and environmental stress brought on by rural land management practices has caused loss in vigour and regeneration of stands of River Red Gums. Without effective conservation management, an irreversible sequence of events may result. This is referred to as the dieback cycle, commencing with progressive branch-tip, tree crown dieback and tree death and concluding with elimination of stands (see Dieback in volume 1).</p> <p>Lack of replacement trees. The original trees are slowly dying, caused by old age and dieback. Within the site there are over 5000 mature trees aged 150 to 500 years. Every year perhaps 50 die, fall or are removed. Dispersed, they go unnoticed. The number increases each year and there is little replacement as livestock grazing has prevented regeneration. There are few trees under 150 years apart from small areas on Fenwick and along roadsides. Many of the old trees along the roads have been removed for overhead wires and saplings are eaten by hares and intermittently by travelling stock. Native shrubs such as wattles and Tree Violet have been eliminated apart from scattered plants on roadsides.</p> <p>Many of the old trees are heavily fire-scarred. The fire of 1851 was said to have razed the entire Volcanic Plains. According to the survey maps of Robert Hoddle, the stony knolls were covered in Drooping Sheoke and Tree Banksia. About five dying sheokes remain in the site. The banksias were wiped out by the grassfires as stock prevented seedling establishment from occurring.</p>	<p>Strengthen Strategic Habitat Link— revegetation and tree planting. Of critical importance to the site is the identification and establishment of a network of local habitat links. Tree and shrub planting in the east and south of the site would restore more complete habitat links between Fenwick Stud and Darebin Creek and Barbers Creek. Narrow links occur along creeks and drainage lines and broader links exist overland through the grassy woodlands and stony knolls. They need to interconnect internally to other stands in the site and externally to other stands in the district. The links need to be placed under grazing exclusion to assist regeneration. Replanting, particularly of native shrubland habitat in gaps within the links, will reduce habitat fragmentation and enable the movement of faunal species. As a Strategic Habitat Link, the site is integral in the maintenance of faunal values in North East Melbourne.</p> <p>These species and livestock benefit from shelter woodlands and shrublands. Fenced areas planted with Yellow Box, Blackwood, Black Wattle, Drooping Sheoke, Tree Bursaria and Tree Violet on the stony knolls and River Red Gum, Swamp Gum, Blackwood and Woolly Tea-tree along the drainage lines should be established. The Fenwick and Surrounds site is a general farming area and existing land-uses continue to apply. A planning overlay of conservation purposes which protect/enhance the biological values of this site and neighbouring sites within the habitat link network is provided by the Strategic Habitat Link.</p> <p>Strategic restoration of natural habitat linkages to isolated stands of River Red Gum could further ameliorate the detrimental effect that habitat loss and fragmentation has had on wildlife populations. To be effective corridors, tree and shrub planting in these links will need to provide structural and floristic diversity and be of adequate width to support forest-dependent insectivores such as the Spotted Pardalote and the Golden and Rufous Whistlers.</p>

Relationship of cover loss and habitat modification with dieback. Census studies of insectivorous birds in the River Red Gum grassy woodlands found that there was a direct relationship between the extent of loss of cover and modification of original vegetation with the severity of dieback (Beardsell 1989; see Volume 1).

Loss of shrub layer increases the rate of eucalyptus leaf damage. Lower rates of defoliation of roadside saplings were observed in sections amongst woodland containing a native grassland understorey. Elimination or depletion of the native understorey habitat (i.e. shrubs, herbs and eucalypt saplings) has also led to a progressive decline in richness and density of beneficial insectivorous shrub layer birds.

Regional Hydrological Strategy

Poor physical and biological condition of the Barber and Darebin creeks. Due to land clearing and farm dams in the catchment there is no flow in the creeks for much of summer and autumn. Superphosphate and animal faeces which enter the creeks after runoff rains cause phosphate and nitrate eutrophication in pools during summer. The elimination of riparian shrub shelter by livestock causes pools to overheat and stagnate. These conditions lead to water de-oxygenation, toxic algal blooms and the elimination of most native fish and instream invertebrates.

Restriction of earthworks which alter the hydrological cycle. Permits should be required for building new dams or increasing the capacity of old dams. Permits for damming creeks should not be issued unless accompanied by a satisfactory Environmental Impact Assessment. Implementing summer–autumn flow from some of the larger dams in the catchment may improve the biologically poor condition of pools in Barbers Creek.

Wetland conservation requires the exclusion of livestock grazing. Wetlands include streamways (the land along all second/third order streams in NEM within 50 m to either side of the banks), drainage lines, swamps and flooded meadows. Livestock trampling and pugging (particularly cattle) of damp marshland substrates lowers the pastoral productivity due to invasion of unpalatable alien grasses such as Sea Barley-grass and Chilean Needle-grass.

Most native species can only persist if protected from grazing in winter and spring. Livestock cause severe damage to native herbfield plants during their growing season in spring. It would be advantageous for the conservation of these species and fauna, such as the locally rare Lowland Copperhead and Red-bellied Black Snake, to protect natural wetland areas (e.g. watercourses and freshwater meadows) from grazing. These areas should be fenced from livestock and protected in accordance with the strategy in Volume 1.

Other Issues

Inadequate conservation incentives and conservation management. The present lack of conservation management incentive available to landowners is contributing to loss in biological values. There is great need for an increase in conservation practices in local farm management.

Intensifying land-use, removal of rocks and native grassland. All properties in the site have been 'picked' of surface rocks (e.g. for rock walls) and many have had the embedded boulders removed for the establishment of improved pasture. A major cause for concern is the increased rate of rock removal and ripping of native grassland. Most of the rocks are taken for urban landscaping. This growth industry needs regulating. Stony crests and rises contain the most significant areas of native grassland. The embedded and surface 'floaters' provide important habitat for grassland reptile and frog species.

Event of residential development in the River Red Gum woodlands. Changes associated with residential development in and adjacent to the Fenwick and Surrounds site have the capacity to fragment stands and reduce tree density. This will cause direct habitat loss and disturbance and lead to further tree dieback and loss of trees and associated fauna. Increased stocking rates and removal of grassland may indirectly lead to land degradation problems such as dryland salting.

Sections of the site near Mernda and Wollert lie at the urban fringe and are slowly being subjected to incremental habitat loss and disturbance associated with urban encroachment. Accompanying the residential encroachment has been escalating municipal farm rates over recent years. This may lead to further subdivision of farms into farmlets or the removal and sale of rocks (critical herpetofauna habitat) from paddocks as a means of income. Little native grassland or fauna of significance survives land-use intensification after subdivision of broad-acre farms into farmlets. Subdivision places the long-term viability of habitat links under threat.

Formation of community land protection group. A LandCare group will be needed if the River Red Gum Protection Zone is to be effectively implemented. The River Red Gum woodland, like most others in GM, occurs on private land. Effective conservation of flora and fauna will entail forming a community-based land protection and management group.

Priority tasks would be to establish grazing exclusion habitat links (particularly stony rise grasslands, freshwater meadows and streamways) and large paddock exclosures for regeneration and indigenous species revegetation and to initiate weed and predator control programs.

Implementation of Native Vegetation Clearance Controls on private land. These should contain restrictions on rock removal, land clearing, cultivation and excessive grazing of significant wetland and grassland habitat. Significant habitat in the River Red Gum Protection Zone includes all trees and areas of native grassland. This includes dead trees and large fallen limbs as well as outcropping rock.

Placental predator control including cats, foxes and roaming dogs. Foxes and roaming domestic cats and dogs have a significant impact on native ground fauna populations and livestock. Feral populations need to be reduced and restrictions on roaming companion animals are strongly advocated. Many of the dogs arise from township areas such as Mernda.

Further Conservation Measures and Examples

Sustainable farm management and nature conservation at Fenwick Stud. The property is a productive, broad-acre farm of mixed livestock. It has a history of low intensity, rotational grazing from horses, cattle and sheep. It has been subjected to sound and sustainable farm management practices over an extensive period. The combination of traditional farming activities and conservation of stony terrain has afforded protection for the grassland vegetation. The large paddocks have remained uncultivated and the stony and gilgai plains remain intact. Other intensive pastoral practices (e.g. supering) have been restricted and the broad-acre rocky paddocks are not heavily grazed for extended periods. The large size of the paddocks disperse the stock grazing pressure. Part of the management includes spelling paddocks for several months each year. This protects native grassland by providing time for recovery and has enabled some River Red Gum regeneration.

The broad-acre paddocks at Fenwick support grassland with diverse natural structure and floristics and an abundance of reptile and ground bird species. Sustainable farm management at Fenwick has conserved the threatened volcanic plains native grassland and grassy woodland habitats. This is measured by the intactness of the embedded rock substrate and vigour of the River Red Gums.

Natural Heritage Area nomination of the Grassy Woodland Critical Conservation Area. This should be considered on the basis of the intactness and extent of the stand of River Red Gum, occurrence of rare species and presence of extensive native grassland. The buildings and land-use history of the properties have very high cultural heritage significance. Nomination as a Natural Heritage Area may make the site eligible for external funding (e.g. National Estate grants) to set up conservation/land protection works. The negotiation of conservation covenants on these properties would be desirable. The concept focuses on conservation enhancement of significant areas and raising community environmental education and cooperation.

Prescribed burning of ungrazed grassland regeneration plots. A system of prescribed burning should be devised to enhance habitat diversity of ungrazed grassland regeneration plots.

Roadside conservation strategy. The roadsides support significant vegetation such as shrubs and eucalyptus saplings generally absent from the paddocks. These plants provide homesites for shrubland species (e.g. Grey Shrike-thrush). The verges should be targeted for priority protection and revegetation projects. A plan to protect roadside grassland remnants should also be devised. The verges should be linear conservation areas serving as habitat links as well as being service easements.

The strategy should entail guidelines for revegetating River Red Gums and replanting the missing tall shrub layer vegetation (Drooping Sheoke, Tree Banksia, Tree Bursaria, Lightwood, Black Wattle, Blackwood and Golden Wattle). Broad strips (at least 20 m) inside paddocks fronting onto the verges should be fenced and replanted so as to form a local habitat link network. This would allow the development of faunal corridors of greater width, diversity and function. This may enable the return of some species which have been eliminated (e.g. Southern Whiteface) or substantially depleted (e.g. Spotted Pardalote and Striated Thornbill). Many of these are important control agents of defoliating leaf insects.

It would be desirable to place speed limits (say 75 km/hour need) on sections of Donnybrook Road and Plenty Road to protect significant populations of animal species (previously discussed). The section of Donnybrook Road between Barber Creek and Selkirk Road and Plenty Road between Masons Lane and Barber Creek are important crossing points for wildlife. Many species of road-killed animals have been seen. Species that are locally scarce which have been recorded on several occasions include the Tawny Frogmouth, Southern Boobook and Eastern Grey Kangaroo. The roads have effectively cut links in the site for Common Wombats, which have been seen as road-kills but not alive. These sections should contain speed restrictions to allow safer passage for wildlife.

Site 16 Plenty River Mernda

Map Reference:	7922 327353 to 7922 332378 (Plenty River). One minute lat/long grids include 37° 35' x 145° 06' to 145° 07' and 37° 36' x 145° 06' to 145° 07'.
Location/Size:	Approximately 430 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: Yan Yean pipe track (Melbourne Water), Streamside Reserve from Bridge Inn Road to Masons Road at Mernda (NRE) and Plenty Gorge Park at Rapaport and Ivanhoe Grammar Mernda (Melbourne Parks and Waterways). Private: zoned PPOS (south of Bridge Inn Road).
Landforms:	Volcanic plain and Foothill (See PLVP A). Elevation is 140–180 m.

Natural Heritage Values

Landscape. The site provides an incursion of the volcanic plains into the sedimentary foothills section of the Eastern Uplands. It contains the only section of the Plenty River with volcanic bedding. The volcanic plains vegetation, while partially degraded and fragmented, is part of very little occurring in a biological reserve in NEM.

Scientific and Educational Values

Invertebrates. The study site of Campbell *et al.* (1982) at Bridge Inn Road recorded a broad diversity of instream invertebrate fauna. The fauna was indicative of some nutrient enrichment although the substrate/vegetation was in good condition. This is characteristic of streams with extensive rural catchments and indicative of the effect of paddock nutrient runoff. The commissioning of the Cades Road sewage treatment plant since the study and the increased level of residential/industrial runoff and discharge from Mernda will have depressed the water quality. The presence of species of mayflies (Ephemeroptera) and stone-flies (Plecoptera) indicates fair water quality conditions, however species sensitive to stream enrichment were absent. The relative abundance of chironomids (midges) and oligochaetes (worms) adapted to low water oxygen levels was indicative of stress conditions. The freshwater shrimp, *Paratya australiensis* was also present.

HABITAT SIGNIFICANCE

For detailed analysis and management discussion refer to Beardsell (in prep.): Yarra–Plenty Catchment. Flora, Vegetation Community Survey and Sites of Botanical Significance. VOLUME 1. Plenty Gorge Park.

Assessment: Medium—Category 1

Partially intact or small stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Manna Gum (riverbank) floodplain riparian woodland (16.4); Woolly Tea-tree riparian scrub (18.2); Golden Wattle–Wedge-leaf Hop-bush cliff/escarpment shrubland (20.4); Lightwood–Tree Violet cliff/escarpment shrubland (20.5)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); River Red Gum (alluvial plain) grassy woodland (14.3); River Red Gum (drainage line) grassy woodland (14.4); Manna Gum (terrace) floodplain riparian woodland (16.5); Kangaroo Grass stony knoll grassland (22.1); Brown-back Wallaby-grass seasonal wetland (25.3)

Rare species: Rye Beetle-grass (western basalt river escarpment on Carome)

Notable features: Strategic Habitat Link. The tessellated basalt pavement above Carome waterfalls contains emergent herbfield of Bare Twig-sedge, Running Marsh-flower, Streaked Arrowgrass and Shiny Swamp-mat while Golden Spray is present on the waterfall rock ledges. Blunt Pondweed and Varied Milfoil occur in the volcanic anabranches and pools upstream of the waterfalls. Tree Banksia on the sedimentary cliffs and Bristly Cloak-fern on the volcanic cliffs are significant. There is a relatively extensive but thinned stand of River Red Gum along the flume track and old Whittlesea Railway and on the surrounding farmland south of Bridge Inn Road.

FAUNAL SIGNIFICANCE : Site 16 Plenty River Mernda

Assessment: Regional—Category 1 (C, D, E, F)

Reference grids for the significance keys include:

16^a: 37° 36' x 145° 06'; Plenty River Mernda

A. Cited Zoological Significance

Local. Biosis (1991)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 16^a: 4 species trapped including the Eastern Freetail Bat and Chocolate Wattled Bat above the river amongst a small stand of River Red Gums along the old Yan Yean pipe track on 25 January 1991 (a fifth species, the White-striped Freetail Bat, was heard on 24 January while setting the traps)

j. Ground mammals

Local. 16^a: 3 species (Echidna, Fat-tailed Dunnart and Platypus) along the river between Carome and the pipe track on 24 January 1991

k. Frogs

Regional. 16^a: 7 species including the Growling Grass Frog and Striped Marsh Frog along the river between Carome and the pipe track on 24 January 1991

l. Reptiles

Regional. 16^a: 7 species including the Bougainville's Skink, Tussock Skink, Eastern Three-lined Skink and Little Whip Snake along the river between Carome and the pipe track on 24 January 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 16^a: over 80 species

b. Native birds

Regional. 16^a: over 50 species

c. Native mammals

Regional. 16^a: 11 species

d. Herpetofauna

Regional. 16^a: 16 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 16^a: 7 species

c. Regionally vulnerable fauna (R2 species)

Regional. 16^a: 2 species. **Mammals**: Fat-tailed Dunnart, Eastern Freetail Bat

d. Regionally rare fauna (R3 species)

Regional. 16^a: 1 species. **Birds**: Little Corella

e. Regionally depleted fauna (R4 species)

Regional. 16^a: 4 species. **Birds**: Latham's Snipe, Whistling Kite, Rainbow Bee-eater. **Mammals**: Platypus

f. Regionally restricted fauna (R5 species)

Regional. 16^a: 8 species. **Birds**: Royal Spoonbill, Australian Shelduck, Little Lorikeet, Singing Bushlark. **Reptiles**: Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs**: Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 16^a: Whistling Kite (stick nest in a River Red Gum on Carome)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Local. 16^a: pair of Latham's Snipe flushed from seasonal meadows along a drainage line north of Sirrianis dam on 24 January 1991

g. Rare/restricted colonial fauna

Regional. 16^a: Flocks of between 200 and 500 Straw-necked Ibis and Australian White Ibis are seen in the site each winter. In the late 1980s and early 1990s while the Gordons Road tip operated these roosted at the top of Yarrambat pool in the Plenty Gorge. In recent years they have roosted at Yan Yean Reservoir. These are large populations of ibis in the context of NEM. Ibis are valuable biological control agents in pastures

m. Regionally rare fauna (R3 species)

Regional. 16^a: 20 Little Corellas at an oaten hay feed trail on Carome on 24 January 1991

Outlook

Continuing degradation of the stream and elimination of the volcanic plains grasslands will lower the faunal significance to Regional Category 2.

FAUNA

Other Significant Fauna

Birds

Ed **16^a: Little Corella.** Small flocks congregate in this site. Twenty birds were seen feeding at an oaten hay feed trail on Carome Stud on 24 January 1991. It is unknown whether these birds came from Yan Yean-Barbers Creek or nested locally in River Red Gum grassy woodland (14.1).

Ee **16^a: Latham's Snipe.** A pair flushed from meadows in River Red Gum grassy woodland (14.4) along a drainage line north of Sirrianis dam on 24 January 1991. The drainage line contained emergent herbfield of Common Spike-sedge, Veined Swamp Wallaby-grass and Brown-back Wallaby-grass.

Ee **16^a: Rainbow Bee-eater.** Two adults with juvenile (presumed bred) in Golden Wattle-Wedge-leaf Hop-bush cliff/escarpment shrubland (20.4) on the sedimentary cliffs downstream of Willis' Mill on 24 January 1991.

Eg **16^a: Nesting Whistling Kite.** A pair bred in a stick-nest in River Red Gum grassy woodland (14.1) on Carome Stud in spring-summer 1990. Adult and juvenile observed on 24 January 1991.

Mammals

Ec **16^a: Fat-tailed Dunnart.** A female with six pouched young was located in a domed grass-nest under rocks and a sheet of corrugated iron in remnant Kangaroo Grass stony knoll grassland (22.1) near the flume track south of Mernda on 24 January 1991. This dunnart inhabits the crumbling brown or red soil of stony knolls on the volcanic plains. They are small, active predators of grassland invertebrates. Skeletal remains in the vicinity of the nest included grasshopper and cricket wings and beetle elytra. The skull of the similar size House Mouse was also present. Most of the suitable stony knoll habitat surrounding nearby Morang Wetlands in Plenty Gorge Park has been eliminated. Trapping studies are recommended in the remnant areas.

Ec **16^a: Eastern Freetail Bat.** One was trapped above the river amongst a small stand of River Red Gum (volcanic plain) grassy woodland (14.1) along the old Yan Yean pipe track on 25 January 1991. Another was trapped 2 km to the south under River Red Gums at the Plenty Gorge Park Morang Wetlands (site 40) in January 1996. This species inhabits grassy woodland and riparian forest in NEM (see site 15). It likely occurs in floodplain riparian woodland downstream in the Plenty Gorge and on the River Red Gum volcanic plains between Blossom Park and South Morang (site 19), where populations would be threatened by housing development.

Ee **16^a: Platypus.** One was seen in a small pool of the Plenty River at the flume bridge on 24 January 1991. The pool was fringed by Woolly Tea-tree riparian scrub (18.2). Individuals may breed locally (e.g. pool below Carome falls) or come from further downstream at Yarrambat pool. Important food including oligochaete worms and the freshwater shrimp (*Paratya australiensis*) was recorded at Bridge Inn Road by Campbell *et al.* (1982).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. The site completes the only connection between all biophysical types in NEM: the ranges, volcanic plains, alluvial plains, upland hills and the Plenty Gorge in the lowland hills. There is a relatively intact habitat link to the Yarrambat–Morang Wetlands site downstream along the Plenty River but the link is partially fragmented and degraded upstream to the Mernda to Yan Yean site.</p>	
<p>Destruction of volcanic plains habitat upstream of the Plenty Gorge Park. Extensive rock clearing has occurred in the last decade on both sides of the river and only refugia grassland remains. Areas of stony knoll grassland are being destroyed or degraded. They have become weed infested by current farm management but still support depleted populations of significant faunal species (e.g. grassland skinks and the Fat-tailed Dunnart). These areas would appear, in the long-term, inadequate to support viable or representative populations of these species unless conservation management practices are soon addressed. Small areas of volcanic plains stony knoll grassland and River Red Gum grassy woodland occur along the old Whittlesea Railway. These will likely be destroyed by future development (e.g. during extension of the proposed light railway to Mernda), severing the already tenuous volcanic plains habitat links to the west and north-west.</p>	<p>Strengthen Strategic Habitat Link—protection of the volcanic plains. The site forms the Strategic Habitat Link between the Yarrambat–Morang Wetlands Ecological Reference Area of the Plenty Gorge and the volcanic plains to the north-west, upland alluvial plains to the north and upland hills to the north-east. It requires urgent conservation management to continue in this capacity. Linkage and prevention of further fragmentation of volcanic plains grassland and grassy woodland habitat is required along the Plenty River. The vital role the site provides as a habitat link requires that it be protected. Revegetating strategic areas of farmland to provide a fuller link is a high priority. Substantially intact stands of grassland within the site of significance should be protected from livestock grazing.</p>
<p>Loss and fragmentation of volcanic plains habitat and future residential development. Critical loss of volcanic plains ground fauna habitat is occurring between the Plenty Gorge Park and Mernda. Residential development has severed habitat links at South Morang and Mernda. On the farmlets south of Mernda, basalt knolls and floaters are being removed for urban landscaping and the grassland is being improved for livestock carrying capacity by sowing of pasture grasses and supering. Rocky grassland sections and their significant fauna are being eliminated. The long-term result of grassland being lost to intensive farming practices will be enhanced River Red Gum dieback and probable elimination (see site 25 and Volume 1).</p>	<p>Conservation management required on the volcanic plains. Extensive land protection and conservation works will be required to preserve the threatened volcanic plains grasslands and grassy woodlands. Loss of the River Red Gum–Kangaroo Grass volcanic plains landscape appears imminent. Most of the properties on the volcanic plains section are hobby farms. These have far greater potential for conflict with flora and fauna values than broad-acre farms (see Fenwick and Surrounds site). Several urgent steps need to be taken to prevent the elimination of the significant volcanic plains biota from the Plenty River environs. Unsustainable management practices on farms leading to the break down of natural ecosystems (e.g. River Red Gum dieback) should be reviewed.</p>

Volcanic plains grasslands flanking the river to the north of the park are proposed for future park acquisition. The present rate of habitat loss and weed invasion is threatening the volcanic plains biota. Trees are scarce in this area and in recent years several of those remaining, including a large and healthy Yellow Box (now rare on basalt), have been bulldozed.

Decline of the Fat-tailed Dunnart. The sighting near the flume track was one of only two records near the Plenty River (the other was at R&D in Plenty Gorge Park, site 42). Widespread removal of basalt floaters and embedded rock between South Morang and Mernda is threatening the long-term viability of the species in the far eastern section of the volcanic plains. The species is undergoing substantial decline in GM due to loss of rocky habitat.

Sustainable land management practices include protection and shrub planting of stony knolls and establishment of natural regeneration plots of River Red Gum. There is urgent need to implement integrated land management practices with those conducted downstream in Plenty Gorge Park. Land-owners need to be exposed to 'hands-on' environmental education programs to improve their conservation awareness.

 Regional Hydrological Strategy

Water contamination hazard from Mernda. High levels of water contamination in the Mernda drain pose a potential health hazard. The water is grey and putrid and outflow may be a risk to aquatic life in the Plenty River. Tests performed by a private environmental assessment consultant and the Environmental Protection Authority in 1994 revealed the water to contain 1000 times the acceptable level of *E. coli* bacteria. These are from faeces, presumably human, originating from local septic tanks and illegal domestic connections to storm water. Other sources include livestock from farm catchments west of the town. The tested water also contained high levels of phosphorous and nitrogen and low dissolved oxygen. Such high nutrient concentration usually leads to the formation of algal blooms, some of which produce toxins which can be fatal to humans, livestock and other life forms.

There are plans to connect septic tanks at Mernda to a regional sewage treatment plant. A plant of similar construction to the Whittlesea plant upstream at Cades Road will do little to improve the water quality of the Plenty River. This is essentially a sieve through which the waste is pumped. It is then treated with chemicals before being discharged into the river. The process is lacking a far more environmentally sound filtration pondage system.

Controls on residential and industrial waste water and runoff.

Monitoring and adherence to water quality controls in the Plenty River.

 Conservation Measures for Other Issues

Implementation of Native Vegetation Clearance Controls on private land. This applies to grassy woodland and rocky grassland vegetation. Reversal of decades of poor management practices requires planning controls at local (e.g. zoning conservation overlays) and state government levels (e.g. implementation of native vegetation clearance controls). Native substrates are unprotected under the framing of the present Native Vegetation Clearance Controls Act of the State of Victoria.

Local government planning controls must be framed which identify and protect ground fauna substrates such as basalt rock outcroppings. Basalt floaters are being removed throughout the district and sold for landscaping purposes in urban growth areas. On the grounds of threatened species and habitat depletion, this aspect of the landscaping industry is in urgent need of control and licensing. Native grassland and substrate clearance controls will need to be enforced in order to protect remaining areas. Native grassland vegetation, rocks, logs and dead trees in proposed or likely areas for future inclusion into the Plenty Gorge Park must be protected.

Site 17 Silver Gum Park Woodstock

Map Reference:	7922 274427 (Silver Gum Park lake). 7922 279430 (mid-point of census plots at rear of Silver Gum Park). One minute lat/long grids include 37° 32' x 145° 02' to 145° 03'.
Location/Size:	Silver Gum Park and adjoining properties on the north side of Donnybrook Road, east of Woodstock. Approximately 320 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	All private land, zoned general farming. Large cattle and goat stud property; sheep and horses. Adjoining farmlets on south side of Donnybrook Road and toward Woodstock.
Landforms:	Volcanic plains (see PLVP A). Elevation is 200–220 m.

Natural Heritage Values

Landscape. A fine stand of mature River Red Gum, lacking native understorey.

Scientific and Educational Values

Scientific reference. River Red Gum bird census plots on Silver Gum Park (plots 27 and 28).

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1)

Remnant, degraded or establishing stands: Kangaroo Grass stony knoll grassland (22.1); Kangaroo Grass plains grassland (23.2; grazing land); Brown-back Wallaby-grass seasonal wetland (25.3); Common Reed-Cumbungi (emergent herbfield) seasonal wetland (25.7); Blunt Pondweed permanent wetland (26.1)

Endangered, vulnerable or rare species: nil

Notable features: River Red Gums on Silver Gum Park. The significance lies in the extensive stand of mature grassy woodland in sections of the property fronting Donnybrook Road and the small stand of regrowth forest to the north of the lake. The site contains some of the largest River Red Gums in NEM. Grassy woodland sections of Silver Gum Park have been cleared of surface rocks and native grassland. Waterbird habitat at Silver Gum Park lake. The lake contains a diverse range of habitats including shallow mudflats, emergent rocks, reed-beds fringing an island, deep open water and large, fringing River Red Gums.

FAUNAL SIGNIFICANCE: Site 17 Silver Gum Park Woodstock

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

17^a: 37° 32' x 145° 02'; Silver Gum Park Woodstock

A. Cited Zoological Significance

Regional. Plenty–Darebin River Red Gum woodlands: Beardsell (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 17^a: Blue-billed Duck, Freckled Duck, Barking Owl

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 17^a: 14 species at Silver Gum Park lake on 25 October 1988; 13 species on 4 October 1988; 10 species on 3 November 1988

d. Breeding waterfowl

Regional. 17^a: 4 species including the Australasian Grebe, Australian Wood Duck, Grey Teal and Pacific Black Duck at Silver Gum Park lake on 3 November 1988

f. Breeding migratory insectivores

Regional. 17^a: 8 species including the Sacred Kingfisher, Rufous Whistler and White-winged Triller on the census plots at Silver Gum Park in October 1988

g. Breeding parrots

Regional. 17^a: 5 species including the Long-billed Corella and Red-rumped Parrot on the census plots at Silver Gum Park in October 1988

k. Frogs

Regional. 17^a: 8 species including the Growling Grass Frog, Striped Marsh Frog and Plains Froglet at Silver Gum Park lake on 25 October 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 17^a: 102 species

b. Native birds

Regional. 17^a: 80 species

c. Native mammals

Regional. 17^a: 7 species

d. Herpetofauna

Regional. 17^a: 15 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 17^a: 16 species

b. Regionally endangered fauna (R1 species)

Regional. 17^a: 2 species. **Birds:** Freckled Duck. **Mammals:** Southern Freetail Bat

c. Regionally vulnerable fauna (R2 species)

Regional. 17^a: 4 species. **Birds:** Crested Pigeon, Black-tailed Native-hen, Barking Owl, Azure Kingfisher

d. Regionally rare fauna (R3 species)

Regional. 17^a: 7 species. **Birds:** Australasian Shoveler, Pink-eared Duck, Hardhead, Blue-billed Duck, Little Corella, White-browed Woodswallow. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 17^a: 3 species. **Birds:** Peregrine Falcon, Rainbow Bee-eater, White-winged Triller

f. Regionally restricted fauna (R5 species)

Regional. 17^a: 9 species. **Birds:** Australian Pelican, Australian Shelduck, Purple-crowned Lorikeet, Long-billed Corella. **Reptiles:** Large Striped Skink, Cunningham's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 17^a: Peregrine Falcon, Little Corella and Long-billed Corella

F. POPULATION DENSITY: Viability and Abundance—point census

c. Waterfowl

Regional. 17^a: 100 birds including a single Freckled Duck took refuge at Silver Gum Park lake after duck opening in early March 1988

Local. 17^a: 56 birds of 4 species at Silver Gum Park lake on 6 December 1988; 42 birds of 6 species on 3 November 1988; 24 birds of 8 species on 4 October 1988

g. Rare/restricted colonial fauna

Regional. 17^a: 800 Straw-necked Ibis and 20 Australian White Ibis roosting at Silver Gum Park lake on 6 December 1988

m. Regionally rare fauna (R3 species)

Regional. 17^a: 30 Little Corellas at Silver Gum Park lake on 25 October 1988

o. Regionally restricted fauna (R5 species)

Regional. 17^a: 50 Long-billed Corellas at Silver Gum Park lake on 4 October 1988; 20 Long-billed Corellas on 25 October 1988

Outlook

Rock clearing of the paddocks has diminished the significance for ground fauna. The lake has improved the significance for waterbirds and frogs.

FAUNA

Rare or Threatened Fauna

Bc 17^a: Freckled Duck and Blue-billed Duck at Silver Gum Park lake. A pair of Blue-billed Duck was seen at the lake on 4 October 1988. A single Freckled Duck took refuge at the lake with 100 other waterfowl after duck opening in early March 1988 (Lloyd Reynoldson pers. comm.). The lake contains permanent open water with beds of Common Reed–Cumbungi emergent herbfield (25.7) near an island, sparse Blunt Pondweed submerged/floating herbfield (26.1) and extensive shallows and rocky shorelines amongst River Red Gum grassy woodland (14.1).

Bc 17^a: Barking Owl at Silver Gum Park. Heard calling in River Red Gum grassy woodland (14.1) on occasion (Lloyd Reynoldson pers. comm.).

Other Significant Fauna

Birds

Ec 17^a: Black-tailed Native-hen. They are seen every four or five years (Lloyd Reynoldson pers. comm.).

Ec 17^a: Azure Kingfisher. One seen on an overhanging River Red Gum limb (14.1) at Silver Gum Park Lake on 12 November 1988. Possibly breeding in the earth wall of the lake.

Ed 17^a: Pink-eared Duck, Hardhead, Australasian Shoveler and other waterbirds at Silver Gum Park lake. Twenty-six species of waterbirds including ten species of waterfowl were recorded on Silver Gum Park lake. The lake is important for waterfowl and frequently contains Pink-eared Ducks, Hardheads and Australasian Shovelers, which are locally scarce. Each was seen in October 1988. Four species of waterfowl including the Australasian Grebe, Australian Wood Duck, Grey Teal and Pacific Black Duck were seen at Silver Gum Park lake on 3 November 1988. The Australian Shelduck was breeding on 23 October 1989. The lake forms a late summer–early autumn refuge as it is one of few large, permanent waterbodies in this section of the volcanic plains. Up to 100 waterfowl congregate at this time of year (Lloyd Reynoldson pers. comm.).

Ed/Fm 17^a: Little Corella. Expanding breeding populations are present (10–20 pair) at Silver Gum Park. An incidence of inter-breeding with the Long-billed Corella was observed and five hybrid birds were seen at a grain trough on 25 October 1988. There were several breeding observations in River Red Gum grassy woodland (14.1) during the October 1988/1989 bird census (see Volume 1 and site 15).

Ee 17^a: Peregrine Falcon. They bred in a large hollow in River Red Gum grassy woodland (14.1) near Silver Gum Park lake in October 1988. While the female was incubating, the male hunted around the lake and River Red Gums for birds such as Common Starlings.

Ee **17^a: Rainbow Bee-eater.** This species was recorded on only two occasions during the Plenty Valley bird census. Birds were recorded on the eastern census plot at Silver Gum Park on 30 October 1989, apparently in passage. This species is now rare on the red gum plains and has shared in the widespread decline of creek-dependent species. Prey and feeding habitat (aquatic insects and riparian shrubs) and breeding habitat (creek banks) have been virtually destroyed. Bee-eaters were formerly rather common.

Ef/Fo **17^a: Long-billed Corella.** Expanding breeding populations are present (30–50 pair) at Silver Gum Park. Frequent breeding observations (usually near water) were made in River Red Gum grassy woodland (14.1) upper trunk hollows and spouts during the October 1988/1989 bird census (see Volume 1 and site 15). Silver Gum Park forms the stronghold of the Long-billed Corella in NEM.

Fg **17^a: Significant ibis roost at Silver Gum Park lake.** Several defoliated River Red Gums around the lake support a substantial seasonal ibis roost (e.g. 800 Straw-necked Ibis and 20 Australian White Ibis on 6 December 1988). The ibis feed on frogs (see *Ck*) around the lake margins and pasture beetle larvae on the damp paddocks in winter.

17^a: Plenty Valley River Red Gum bird census. The density of trees in the regrowth forest to the north of Silver Gum Park lake influences the presence of several forest-dependent insectivores, normally scarce in River Red Gums. These include the Shining Bronze-Cuckoo, Rufous Whistler, Spotted Pardalote (large numbers), Striated Thornbill, Grey Shrike-thrush, Grey Fantail, Varied Sittella and Yellow-faced Honeyeater. In the two census plots on the rear of Silver Gum Park the tree density and associated foliage bird diversity has kept the rate of leaf defoliation from insects to the lowest observed in the two-year census study (October 1988/1989; see Volume 1).

River Red Gum tree hollows at Silver Gum Park were found to be important for nesting parrots. Five species including the Little Corella, Long-billed Corella and Red-rumped Parrot were recorded breeding on the bird census plots in October 1988. Several birds of prey were also recorded nesting, including the Peregrine Falcon in October 1988. The River Red Gums were also important for migratory insectivores. Eight species including the Sacred Kingfisher, Rufous Whistler and White-winged Triller were breeding on the census plots in October 1988.

Mammals

Eb **17^a: Southern Freetail Bat.** One was trapped along with a single Large Forest Bat in River Red Gum grassy woodland (14.1) at the north side of Silver Gum Park lake on 4 November 1988. The Southern Freetail Bat has only been trapped in grassy woodland in GM (see site 15).

Frogs

Ck **17^a: Silver Gum Park lake.** Eight species including the Growling Grass Frog, Striped Marsh Frog and Plains Froglet were recorded on 25 October 1988. The Plains Froglet is rare in the Plenty Volcanic Plains. The Peron's Tree Frog is likely present (see site 15). The Common Spadefoot Toad would be present but the site was not visited while the toad would have been calling (wet nights) in autumn–winter (see site 15).

MANAGEMENT

Threatening Processes

(See Fenwick and Surrounds site.)

Rock clearing. This site has undergone extensive rock clearing and consequently the native ground flora is poorly represented.

Lack of River Red Gum regeneration.

Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. Fragmented habitat links to the Fenwick and Surrounds site and north along the Barber Creek to the Eden Hills site.

System of grazing exclusion habitat links for revegetation. Sections should be fenced to enable natural regeneration of River Red Gums and planting of a structurally diverse shrub layer of Black Wattle, Golden Wattle, Blackwood and Drooping Sheoke. This will provide habitat for breeding populations of forest-dependent foliage birds. A system of strip exclosures should be developed along fencelines. Electric fences are already present. These should be moved further into the paddocks to create a strip at least 10 m wide on each side of the fence. The ground layer is highly modified, supered and composed of alien pasture grasses. The loss of native grasses and native biological control agents in the pasture has favoured pasture insects (e.g. Christmas Beetles). This will make the re-establishment of eucalypts more difficult.

Other Issues

Provision of additional waterbird habitat on Silver Gum Park lake. Sections of the grazed mudflats should be fenced to allow regeneration of River Red Gums and the development of the seasonal wetland fringe (e.g. Veined Swamp Wallaby-grass and Common Spike-sedge). This would provide taller and denser habitat for cover-dependent species (e.g. snipe, crakes and rails). It would also provide habitat for invertebrates (e.g. substrate for emerging damselflies). Placing flat logs and rocks around the shoreline would provide habitat for crustaceans, which are important food for wading birds. Establishing a greater diversity of invertebrate food-chain species will attract more waterbirds.

Planting indigenous shrubs along the bank and on the island would provide more nesting and roosting habitat (e.g. for the Nankeen Night Heron). The island and surrounding reed-bed is important for common species of nesting waterbirds (e.g. Dusky Moorhens). Rarer species (e.g. Australasian Shoveler and Blue-billed Duck) might be encouraged by constructing nesting platforms on the island. Providing rafts may encourage some species (e.g. Purple Swamphen). With additional habitat, the dam would likely attract a further 10–15 species of waterbirds, some of which would be rare or threatened.

Implementation of Native Vegetation Clearance Controls on private land.

PLVP B EPPING–SOUTH MORANG

This management unit consists of three sites of regional faunal significance (sites 18, 19 and 20) and surrounding land that forms habitat links.

Map Reference: 7922 267327 to 7922 291385 (Darebin Creek); 7922 287345 (Quarry Hill trig point).

Location/Size: Quarry Hill, the Darebin Creek from Findon Road Epping to Masons Lane Wollert and the plains to the east from Blossom Park to Mernda separating Quarry Hill from the Plenty Gorge. Approximately 4000 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands. It contains a Devonian granodiorite outcrop (Quarry Hill) and surrounding Quaternary volcanic plains situated between the sedimentary foothills of the Eastern Uplands and the Western Volcanic Plains. On a physiographic/geological basis, Quarry Hill could be split into a biophysical zone of its own. On the basis of geographical proximity and broad floristic and faunal affinities, it is included in the Plenty Lowland Volcanic Plains.

Landforms

Foothill: granitic tors, hill-crests, hill-slopes, valleys, gullies, ephemeral drainage lines and quarry (Quarry Hill). Alluvial plain: creek escarpment (lower Darebin), sand-crest (Bundoora Park), plain-slopes (Quarry Hill and lower Darebin) and swamp (Mernda swamp). Volcanic plain: hill-crest cappings, stony crests, stony rises, stony plains, silt plains, gilgai plains, swales, swamps (drained), quarry, farm lakes, creek escarpment/floodplains (middle Darebin) and ephemeral drainage lines. Elevation is 120–272 m (summit of Quarry Hill).

Hydrology

The unit contains the floodplains and catchments of Darebin Creek, draining the western slopes of Quarry Hill and some minor tributaries of the Plenty River, draining the southern and eastern slopes of Quarry Hill. Darebin Creek is ephemeral upstream of Epping and perennial, fed from urban runoff, downstream of Epping. It has low, columnar basalt cliffs, tessellated pavements, shallow, dry cobble and sand sections, rocky reefs and small waterfalls and open water pools up to 1 m deep, lined with reeds.

There are freshwater meadows at the aprons of extensive stony rises. Impoundments occur on the south-west outskirts of Wollert and to the north-west of the intersection of Hunters Lane and Plenty Road (power boat racing lake). The creeks that flow off Quarry Hill are ephemeral, carrying water during winter–spring and after runoff rain at other times of the year. It is likely that before land clearing and the construction of farm dams some on the eastern and southern slopes ran for much of the year. There were swamps along tributaries of the Darebin Creek to the north-west and in the valley to the north-east of Quarry Hill. They are now drained.

Rainfall: 630–660 mm.

Site 18 Epping to Wollert

- Map Reference:** 7922 267327 to 7922 291385 (Darebin Creek); 7922 257322 (Epping Cemetery). One minute lat/long grids include 37° 35' x 145° 00' to 145° 05', 37° 36' x 145° 00' to 145° 03', 37° 37' x 145° 02' and 37° 38' x 145° 01' to 145° 02'.
- Location/Size:** Darebin Creek from Findon Road Epping to Masons Lane Wollert. Approximately 700 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: Epping Cemetery (City of Whittlesea). Private: quarry (extractive, owned by Pioneer), remainder general farming, mostly farmlets.
- Landforms:** Volcanic plain (see PLVP B). Elevation is 140–210 m.

Natural Heritage Values

Landscape. The most valuable natural features for biota occur along Darebin Creek and on stony knolls. The stone walls and buildings are of considerable cultural heritage significance.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1; Epping Cemetery); River Red Gum (drainage line) grassy woodland (14.4); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Common Tussock–grass plains grassland (23.1); Kangaroo Grass plains grassland (23.2; grazing land); Brown-back Wallaby–grass seasonal wetland (25.3)

Remnant, degraded or establishing stands: Common Spike–sedge drainage line herbfield (24.1); Common Tussock–grass–Rush Sedge (grassy) seasonal wetland (25.2); Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7)

Vulnerable species: Matted Flax-lily (recently extinct at Epping Cemetery), Swamp Groundsel (recently extinct at Epping Cemetery); Swamp Plantain (recently eliminated from Epping Cemetery)

Rare species: Blown Grass (*Agrostis aemula* var. *setifolia*; recently extinct at Epping Cemetery), Swamp Billy-buttons (3 plants remained at Epping Cemetery in September 1994)

Notable features: Epping Cemetery supports one of the most diverse volcanic plain grassy woodland remnants in NEM. Of particular importance are several species including the Nodding Chocolate-lily, Bulbine Lily, Milkmaids, Blue Grass-lily, Hairy Weather-grass, Snake Orchid, Swamp Billy-buttons, Spur Velleia, Plains Candles and Smooth Rice-flower which have been virtually eliminated from farmland in the district. The southern section was incorporated into the Epping Recreation Reserve in 1994. Part of the grassy woodland was destroyed and a small area of Very High habitat significance Brown-back Wallaby–grass seasonal wetland which supported five VROT plant species was eliminated. The remaining grassy woodland has become fragmented and partially degraded. A small area of stony knoll grassland remains in the west section.

Darebin Creek supports significant drainage line grassy woodland and cliff/escarpment shrubland. Away from the creek there are scattered areas of significant species and habitats including grassy woodland at Cheshire Park (opposite Lehmanns Road on Bindts Road) and Pioneer, grassy seasonal wetland at Bindts Road south of Bridge Inn Road and stony knoll grassland at Bindts Road and Pioneer. Each is becoming increasingly fragmented and degraded.

With management works, the conservation status of drainage line woodland and cliff/escarpment shrubland along Darebin Creek could be restored to relatively intact and extensive (High habitat significance). The site originally supported extensive grassy woodland (or plains grassland in the absence of River Red Gums) on the grey soil gilgai plains and stony plains. Seasonal wetland and drainage line herbfield occurred in black soil swales and drainage lines and stony knoll grassland (formerly shrubland) on red/brown soil stony knolls.

FAUNAL SIGNIFICANCE: Site 18 Epping to Wollert

Assessment: Regional—Category 2 (C, D, E, F)

Reference grids for the significance keys include:

18^a: 37° 35' x 145° 02'; Pioneer Quarry

18^b: 37° 35' x 145° 03'; Darebin Creek Bridge Inn Road to Masons Lane

18^c: 37° 36' x 145° 02'; Bindts Road/Lehmanns Road Wollert

18^d: 37° 38' x 145° 01'; Epping Cemetery/Darebin Creek at Findon Road

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 18^c: 11 species including the Brown Quail, Buff-banded Rail and Latham's Snipe at Bindts Road Swamp on 6 December 1988

Local. 18^a: 10 species at Pioneer Quarry wetland on 23 June 1988

k. Frogs

Regional. 18^c: 6 species including the Plains Froglet at Bindts Road Swamp on 6 December 1988

Regional. 18^a: 6 species including the Striped Marsh Frog in the north section of Pioneer Quarry (heard from Masons Lane) on 9 December 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 18^c: 52 species

Local. 18^a: 24 species. **18^d**: 24 species

d. Herpetofauna

Regional. 18^c: 13 species

Local. 18^d: 7 species. **18^a**: 7 species (all frogs)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 18^c: 13 species. **18^{bd}**: 1 species

b. Regionally endangered fauna (R1 species)

Regional. 18^c: 2 species. **Birds**: Cockatiel, White-backed Swallow

c. Regionally vulnerable fauna (R2 species)

Regional. 18^c: 4 species. **Birds**: Crested Pigeon, Spotted Harrier, Diamond Firetail. **Mammals**: Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 18^c: 1 species. **Frogs**: Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 18^c: 6 species. **Birds**: Brown Quail, Buff-banded Rail, Latham's Snipe, Peregrine Falcon, Striated Fieldwren, Rufous Songlark

Local. 18^b: 1 species. **Birds**: Rufous Songlark

Local. 18^d: 1 species. **Birds**: Striated Fieldwren

f. Regionally restricted fauna (R5 species)

Regional. 18^c: 10 species. **Birds**: Little Eagle, Long-billed Corella, Purple-crowned Lorikeet, Little Lorikeet, Brown Songlark, Singing Bushlark. **Reptiles**: Large Striped Skink, Tussock Skink. **Frogs**: Striped Marsh Frog, Common Spadefoot Toad

Local. 18^d: 5 species. **Birds:** Australian Hobby. **Reptiles:** Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

Local. 18^a: 1 species. **Birds:** Australian Shelduck

Local. 18^b: 1 species. **Frogs:** Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 18^c: Spotted Harrier and Cockatiel at Bindts Road Wollert

f. POPULATION DENSITY: Viability and Abundance—point census

c. Waterfowl

Local. 18^a: 75 birds of 8 species including 10 Eurasian Coot, 6 Hoary-headed Grebe, 37 Black Swan and 8 Australian Shelduck at Pioneer Quarry wetland north-east of Wollert on 23 June 1988

h. Other fauna

Local. 18^a: Black Swan (37 at the Pioneer Quarry wetland on 23 June 1988)

k. Regionally endangered fauna (R1 species)

Regional. 18^c: 6 White-backed Swallows on the power lines along Bindts Road about 800 m south of Bridge Inn Road on 6 March 1990

l. Regionally vulnerable fauna (R2 species)

Regional. 18^c: 5 Spotted Harriers (2 adults and 3 fledged young) seen at Bindts Road Wollert on 15 February 1989

Outlook

The faunal significance of grassland ground fauna species and grassy woodland fauna has declined due to land management (e.g. rock clearing and River Red Gum dieback). As farmland subdivision and rock clearing of paddocks ensue, faunal significance will decline to Regional Category 3 in the absence of conservation management.

FAUNA

Rare or Threatened Fauna

Bb 18^c: Regionally extinct birds—Bush Stone-curlew. Persisted in River Red Gum grassy woodland (14.1) south-east of Wollert until the 1920s (Evelyn Draper pers. comm.). The curlew was probably eliminated by a combination of predation from foxes and cats, shooting and the loss of low shelter trees such as Drooping Sheoke, Lightwood and Tree Banksia from grazing lands.

Bc 18^c: Regionally extinct birds—Superb Parrot. Persisted in River Red Gum grassy woodland (14.1) south-east of Wollert until the 1920s (Evelyn Draper pers. comm.). Trapping for aviculture and egg collecting in the late nineteenth and early twentieth century and the elimination of grassland and tall shrubland feeding habitat are implicated in the decline of the Superb Parrot.

Other Significant Fauna

Birds

Eb 18^c: Cockatiel. Several inland migratory bird species including the Spotted Harrier, Cockatiel and White-backed Swallow were observed in the middle reaches of the Darebin Creek. A nesting pair of Cockatiel with one dependent young was seen in a hollow spout of a River Red Gum (grassy woodland; 14.1) on 'Cheshire Park' along Bindts Road near Wollert on 15 November 1988. The birds were observed on several occasions over the following weeks.

Their main food was the seeds of field layer plants, particularly native grasses and Grassland Crane's-bill and introduced herbs (e.g. Prostrate Knotweed, Cat's-ear and clovers). They also fed on fallen thistle seeds and cereal grain, taken from a farmyard. They occasionally foraged in the River Red Gum foliage, apparently on psyllid insects and flower buds. Cockatiel have become very rare in southern Victoria. They are annual summer breeding

migrants from the inland to northern Victoria, but are sporadic in southern Victoria, most frequently visiting the You Yangs during droughts.

Eb **18^c: White-backed Swallow.** Six were perched on power lines along Bindts Road about 800 m south of Bridge Inn Road on 6 March 1990. There were only five records in GM during the 1986–1996 survey period. Near the You Yangs, the swallow nests and roosts in burrows at gravel pits and near water in eroded gravel banks of creeks under River Red Gum grassy woodland. They possibly breed in gravel gullies on hill-slopes of Quarry Hill (site 20). They are thought to be rare annual migrants. The birds appeared to be in pre-migratory behaviour (see site 14).

Ec **18^c: Crested Pigeon and Diamond Firetail.** Both species were observed on 15 February 1989. The pigeon was sitting on overhead wires near Cheshire Park along Bindts Road in River Red Gum grassy woodland (14.1). Four firetails were seen in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) on Darebin Creek south of Bridge Inn Road. Populations of both species have been altered by the advent of pastoralism. The pigeon has increased due to the availability of cereal grain and seeds of wasteland weeds (see site 15). The firetail has become rare due to the loss of tall-grass and shrubland nesting habitat. Seasonally mobile populations of firetails persist on the broad-acre grasslands of the Merri, Edgars and Darebin creeks (see sites 11, 12 and 13).

Ec **18^c: Spotted Harrier.** They rear young opportunistically, according to prey availability. A pair reared three during a local mouse plague in the summer of 1988–89 in an abandoned raptor nest (possibly Little Eagle) in River Red Gum grassy woodland (14.1) near Darebin Creek, south-east of Wollert. The young were last seen flying with the adults on 15 February 1989. Spotted Harriers take food, including the House Mouse, from the ground, while coursing low over cereal stubble and grazing land. They also take reptiles, birds, small rabbits and insects (Readers Digest 1986).

Ee **18^c: Brown Quail, Buff-banded Rail, Latham's Snipe and other waterbirds of Bindts Road Swamp.** This drainage line swamp about 500 m south of Bridge Inn Road supports remnant Common Tussock-grass–Rush Sedge (grassy) seasonal wetland (25.2). Most of the swamp has been cultivated but it was being only lightly grazed in spring 1988. Small stands of seasonal wetland occur along the channels. In wet years water is present for several months during spring and early summer. At these times adequate cover is provided by Common Spike-sedge. Eleven species including the Pacific Black Duck, Grey Teal and Australian Wood Duck were recorded on 6 December 1988. A Buff-banded Rail and two Latham's Snipe were flushed from the drainage channels. Two male Brown Quail were heard calling from the swamp at sundown. Several species of marshland passerines were recorded nesting. These included the Singing Bushlark, Brown Songlark, Golden-headed Cisticola and Striated Fieldwren.

Management of the swamp could be vastly improved. A similar swamp of potential significance occurs near Darebin Creek, downstream of Masons Lane (grid 18^b). The swamp contains a higher proportion of native grassy wetland vegetation but is heavily grazed by livestock. Protection from grazing in winter and spring would attract cover-dependent waterbird species.

Ee **18^{bc}: Rufous Songlark stronghold and important habitat links to the north.** The woodlands of the site connect the Fenwick and Surrounds site along Masons Lane, through Pioneer. They are the main link downstream along Darebin Creek from the Fenwick site. Rufous Songlarks were recorded nesting in River Red Gum grassy woodland (14.1) along Masons Lane on 2 December 1986 and Bindts Road on 23 October 1989. The old River Red Gums present supported substantial populations of parrots, particularly the Red-rumped Parrot and Eastern Rosella. The potential for a diverse bat fauna is high on the basis of the size and availability of nest hollows in these trees. The mature River Red Gums on Pioneer support good habitat for bats but permission to conduct bat trapping was refused by the quarry management.

Ef **18^a: Australian Shelduck and other waterbirds of Pioneer Quarry wetland.** Ten waterbird species were observed on 23 June 1988. There were eight species of waterfowl included 10 Eurasian Coot, 6 Hoary-headed Grebe, 37 Black Swan and 8 Australian Shelduck.

Mammals

Ec **18^c: Fat-tailed Dunnart on the Darebin Creek escarpment south of Bridge Inn Road.** One was located under a rock amongst crumbling red/brown soil in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) adjacent to the Darebin Creek, south of Bridge Inn Road on 15 February 1989.

Reptiles

Ef **18^{cd}: Tussock Skink and other grassland reptiles of the middle Darebin.** Extensive herpetofauna searches were not conducted in the site. Searches were confined to the basalt cliffs and escarpments of Darebin Creek south of Bridge Inn Road (**18^c**) and north of Findon Road (**18^d**). Epping Cemetery (**18^d**) was searched on two occasions. The Large Striped Skink and Eastern Three-lined Skink were recorded in Lightwood–Tree Violet cliff/escarpment shrubland (20.5) south of Bridge Inn Road on 4 July 1988. A Bougainville’s Skink and Little Whip Snake were recorded in cliff/escarpment shrubland at Findon Road on 29 September 1988. The Tussock Skink was located in Kangaroo Grass stony knoll grassland (22.1) on the plains fronting the creek. One was also located in River Red Gum grassy woodland (14.1) at Epping Cemetery on 4 October 1991.

A diverse range of species is expected along the creek on the basis of habitat. A Lowland Copperhead was recorded under a log in River Red Gum (drainage line) grassy woodland (14.4) along Darebin Creek north of Harvest Home Road on 29 September 1988. The species has become rare in urban sections downstream (e.g. BMG Quarry–Howy’s site). Additional species would likely include the Marbled Gecko, Southern Water Skink, Red-bellied Black Snake, Eastern Brown Snake. Sections of habitat along Darebin Creek appear suitable for the vulnerable Striped Legless Lizard.

Frogs

Ed **18^c: Plains Froglet at Bindts Road Swamp.** One was calling from Common Tussock-grass–Rush Sedge seasonal wetland (25.2) on 6 December 1988.

Ef **18^{cd}: Common Spadefoot Toad.** Several were calling after rain from flooded gilgai swales and shallow drainage lines (Brown-back Wallaby-grass seasonal wetland; 25.3) at Epping Cemetery on the evening of 2 June 1990. One was located in a burrow on 4 October 1991 at the cemetery. One was also calling in Common Tussock-grass–Rush Sedge seasonal wetland (25.2) at Bindts Road Swamp on 29 September 1988.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Intact habitat link to the Fenwick and Surrounds site. Fragmented links to the Quarry Hill site, Edgars Creek Headwaters site and Summerhill Road site.	
Advance of residential development and farm subdivision. These are viewed as the primary threats to the biological (and other) significance values of the site.	

Loss and fragmentation of native grassland and habitat links. The grassland ecosystem in many areas bordering the site has been eliminated and that within the site is becoming degraded and fragmented. It has less ability to function adequately, resulting in lower natural diversity and ingression of alien species.

Habitat elimination by urban development. Similar to what has happened at Mill Park and Blossom Park, the fragile and fragmented vegetation within the site will be eliminated with the encroachment of residential development in the proposed Epping growth 'bubble'. Habitat in outlying sections of the site towards Wollert is being eliminated by farm subdivision and intensification.

Defoliation and dieback of River Red Gums. Stands of River Red Gum are fragmented and undergoing excessive defoliation rate and dieback (see Fenwick and Surrounds and Mernda to Yan Yean sites and Volume 1).

Strengthen habitat links. Protection and enhancement of habitat links to the Fenwick and Surrounds site is critical.

Protect native grassland remnants. Flora values steadily decline as a result of land settlement pressures. The site still supports a high diversity of partially intact habitat stands. With effective conservation management, flora values could be maintained, or possibly improved. A concerted effort should be made to slow down the spread of urban growth within the site. The grassland remnants are significant and should be conserved. An improvement is needed in the current poor land management, which is eroding flora and faunal values.

Regional Hydrological Strategy

Reduction of summer flow and water quality in Darebin Creek. The rate of flow of Darebin Creek has decreased noticeably over the last 20 years. This may be due to the proliferation of farm dams, particularly large in-stream dams, along its tributaries. The watertable around the Pioneer Quarry appears to be interconnected with Darebin Creek. The quarry may have also interrupted the flow of the creek.

Rehabilitation of Darebin Creek swamps. Two swamps, which were formerly shallow freshwater marshes but are now freshwater meadows near the Darebin Creek (south of Masons Road and Bindts Road Swamp south of Bridge Inn Road), have been drained and heavily grazed by livestock. If grazing were to cease and the drains were partially filled, the swamps would support significant populations of waterbirds. Shallow freshwater marshes on the Plenty/Merri Volcanic Plains have been obliterated since settlement. Several of the quarries at Pioneer contain water and muddy/rocky shorelines, which attract waders, and are starting to develop aquatic herbfields, which attract waterfowl.

Weed invasion/elimination of instream fauna and riparian vegetation. Native fish including the Freshwater Blackfish were present in deeper holes along the creek in the 1970s. They may now be eliminated due to years of poor land-use. The water volume and quality of these holes declines over summer to levels where fish (apart from eels) find it difficult to survive. Stock and rabbits scour the creek-bed and strip the escarpment. The escarpment and stony knoll shrublands have died out or are being replaced by Gorse and African Box-thorn. Most of the old River Red Gums along the creek have died, without replacements. The stream is on the verge of becoming a weedy drain as a result of local attitude.

Salination. Areas of Sharp Rush infestation along Darebin Creek and the death of the River Red Gums may be an indication of rising salinity (see Summerhill Road site).

Streamway conservation management of Darebin Creek and the formation of LandCare group. In relation to other creeks in NEM, the Darebin has been subjected to severely degrading land-uses. A dramatic change of public attitude is needed so that the creek is viewed from conservation and aesthetic perspectives. Two decades ago the water and habitat quality of the middle section of the creek was far superior (aesthetically and biologically) to today. A land and hydrological management plan is required for Darebin Creek entailing extensive weed control and replanting of indigenous vegetation.

This can be best achieved by placing a conservation planning overlay over the stream frontage of properties lying along the creek. Such properties under appropriate conservation covenants and habitat works should be considered for rate rebate as an incentive to protect native habitat. A local landcare group should form. Hydrological and water quality studies should be conducted to determine the effect of damming, quarrying and catchment land-use. A hydrological strategy should be formulated for the creek with the aim of restoring aquatic ecosystems.

Other Issues

Rock clearing. There is a high rate of removal of basalt rocks from paddocks. This is particularly associated with houseblock development around the rural fringe of Wollert. The rocks provide shelter for significant grassland fauna species.

Grassland degradation and elimination of seasonal wetland at Epping Cemetery. The quality of the grassland vegetation at Epping Cemetery is deteriorating. Some sections are mowed and weeds, including Paspalum, have invaded low-lying areas while others, including Montpellier Broom, are expanding. A stand of Very High significance seasonal wetland (including 4 VROT plants) in the south section of the cemetery was destroyed when the area was redeveloped into the Epping Recreation Reserve in 1994.

Implementation of Native Vegetation Clearance Controls on private land.

Grassland management at Epping Cemetery. A management plan needs to be prepared to prevent further loss or degradation of areas of native grassland. There should not be any burials in significant sections of grassland. Escapees from amenity plantings such as Freesia, African Box-thorn and Aleppo Pine need controlling. The mature pines have historical significance and should not be removed. Weeds from surrounding disturbed areas and pasture, such as Sweet Vernal-grass, also need controlling.

Areas of significant vegetation need to be mapped so that management can focus on rehabilitation works. Survey for the VROT species which appear to have been eliminated should be conducted in the chance that plants remain. Enrichment planting of these and other rare grassland species from the district should be considered. Several weeds, including Paspalum and Montpellier Broom, need to be eradicated. Trial burning plots should be established and monitored. This may stimulate the re-appearance of dormant geophytes (e.g. orchids).

**Nomination of Epping Cemetery as a flora
reserve.**

Site 19 Mill Park–Blossom Park

Map Reference:	7922 288308. One minute lat/long grids include 37° 38' x 145° 03', 37° 39' x 145° 02' to 145° 05', 37° 40' x 145° 02' to 145° 03'.
Location/Size:	South of McDonalds Road between the Darebin Creek and Plenty River. Approximately 600 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: old Whittlesea Railway. Private: farms and advancing urban development.
Landforms:	Volcanic plain and alluvial plain (see PLVP B). Elevation is 90–130 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 3 (Medium—1) when surveyed from 1986-88)

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1*); Common Reed–Cumbungi seasonal wetland (25.7; Peter Hopper Lake Mill Park); * = relatively intact and extensive stand prior to 1988

Remnant, degraded or establishing stands: River Red Gum (drainage line) grassy woodland (14.4*); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1*); Brown-back Wallaby-grass seasonal wetland (25.3); Blunt Pondweed permanent wetland (26.1; Peter Hopper Lake Mill Park); * = partially intact stand prior to 1988

VROT species: unsurveyed; record of Dusky Scurf-pea from old Whittlesea Railway Reserve north of McDonalds Road in late 1970s.

Notable features: River Red Gum in proposed development near McDonalds Road.

FAUNAL SIGNIFICANCE: Site 19 Mill Park–Blossom Park

Assessment: Regional—Category 3 (B, C, D, E)

Reference grids for the significance keys include:

19^a: 37° 39' x 145° 02'; Darebin Creek at Epping

19^b: 37° 39' x 145° 03'; Mill Park

19^c: 37° 39' x 145° 04'; Plenty Road/Blossom Park/McDonalds Road

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 19^b: Barking Owl at Mill Park in May 1990

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 19^c: 4 species triplined at a dam near Plenty Road at the Blossom Park riding school on 1 March 1989

l. Reptiles

Regional. 19^b: 7 species including the Marbled Gecko, Cunningham's Skink and Bougainville's Skink on the stony rises amongst the developing urban area near Pindari Avenue in January 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

d. Herpetofauna

Regional. 19^{bc}: 9 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 19^b: 3 species

c. Regionally vulnerable fauna (R2 species)

Regional. 19^b: 2 species. **Birds:** Barking Owl. **Mammals:** Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 19^b: 1 species. **Frogs:** Marbled Gecko

f. Regionally restricted fauna (R5 species)

Local. 19^b: 4 species. **Reptiles:** Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink

Local. 19^c: 4 species. **Birds:** Little Lorikeet. **Reptiles:** Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

Outlook

Urban development caused the faunal significance to decline from Regional Category 1 in 1986 to Category 3 in 1993; this will become local when the next wave of development commences.

FAUNA

Note. By the time the site was surveyed in late 1988, biological values had dramatically declined. It was not extensively surveyed due to expediencies of time/resources, which were put into more important and secure areas.

Rare or Threatened Fauna

Bc 19^b: Barking Owl. A bird was heard calling from River Red Gum grassy woodland (14.1) at the northern edge of Mill Park (now urban) in May 1990 (Alan Webster pers. comm.). Prior to recent urban development, the site probably provided feeding grounds outside the breeding season for birds from Plenty–Janefield (site 42) and the River Red Gum grassy woodlands of Fenwick and Surrounds (site 15) to the north. It is unlikely the owl still visits.

Other Significant Fauna

Mammals

Ec 19^b: Fat-tailed Dunnart. The dunnarts inhabited the crumbling red and brown soil on stony knolls. The end of Pindari Drive was cleared for housing in 1989. Two dunnarts located under rocks were translocated to the pipe track area north of Blossom Park in Plenty Gorge (Grant Turner pers. comm.). They were formerly common downstream of the site at Bundoora and upstream at Epping but their habitat has been largely overtaken by residential development.

Reptiles

Ed 19^b: Marbled Gecko and other reptiles before the onset of housing. The site supported a diverse assemblage of reptiles before the onset of housing in the late 1970s. By 1986, when first surveyed, extensive areas had been eliminated. There was still intact River Red Gum grassy woodland (14.1) and Kangaroo Grass stony knoll grassland (22.1) in the northern section of Mill Park. Such was the rapidity of development that by the time the site was scheduled for intensive survey in late 1988 much was gone.

Reptile data was compiled by Grant Turner, who conducted field surveys between Darebin Creek and Plenty River just prior to development. Stony rises near Plenty Road where MacDonaldis now stands contained the Little Whip Snake. Stony rises on Mill Park near Pindari Avenue contained a diverse assemblage including the Large Striped Skink, Bougainville's Skink, Cunningham's Skink and Marbled Gecko.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. There is an intact habitat link from Blossom Park to the Plenty–Jane field site and fragmented grassland links to the Quarry Hill site.

Habitat loss and fragmentation by residential development. The site is on the urban fringe in an area currently being developed or proposed for development within the Plenty Growth Corridor (MPE 1990). A number of rarer ground fauna species (e.g. Fat-tailed Dunnart and Marbled Gecko) were recorded only from areas that have now been cleared for development (Grant Turner pers. comm.).

Severance of habitat links. Plenty Road, urban expansion of South Morang and surrounding farmland development have restricted the movement of ground fauna through the site from the Plenty Gorge to Quarry Hill. Road-killed Common Wombats, Eastern Grey Kangaroos and Black Wallabies have been observed along Plenty Road at the closest approach of the two areas near the corner of Wilton Vale Road.

Strengthen habitat links. Stock removal and strategic restoration of natural habitat linkages to isolated stands of River Red Gum could ameliorate the detrimental effect that habitat loss and fragmentation has had on wildlife populations. Through natural regeneration and supplementary planting, fingers of native vegetation could pass through public open space in the proposed urban development area, providing missing habitat links for native fauna. To maintain tree health and be effective corridors, tree and shrub plantings need to have adequate width and connectivity and structural and floristic diversity so as to support forest-dependent insectivores (e.g. the Spotted Pardalote and Golden and Rufous Whistlers). The use of indigenous plant species along streets and in commercial, industrial and housing estates would complement the habitat links.

Development of habitat nodes along the habitat links. In fragmented sites, ultimate biological value rests on the connectivity of habitat links and the size of habitat nodes in the system. Effective faunal movement relies on nodes of adequate area and diversity at intervals along the link. The viability of species requiring large areas of natural habitat (e.g. Barking Owl) in neighbouring sites may be dependent on these as intermittent roosts during times of low prey abundance. The woodland nodes must be 1–2 ha for the link to function. This would provide habitat for species which cannot persist in (but may pass through) the linear links.

Defoliation and dieback of River Red Gums.

By the early 1990s, River Red Gums beyond the present urban development to the south of McDonalds Road were in decline and displayed severe dieback symptoms caused by insect (predominantly psyllid) defoliation. With grazing suspended in recent years, regeneration is occurring and the rate of defoliation has declined. The stands will be eliminated when development extends to McDonalds Road. The most severe leaf defoliation is occurring amongst isolated mature trees in farmland and residential areas. This is largely due to long-term stress related factors resulting from clearing and degradation of native vegetation and severance of habitat links, which have caused loss of insectivorous birds and parasitic and predator insects (see Mernda to Yan Yean, Fenwick and Surrounds and Gresswell Forest sites and Volume 1). The remnant River Red Gums at Mill Park are dying because of stress arising from altered hydrology and leaf defoliation by insects in the absence of adequate numbers of foliage birds.

Classification and protection of all River Red Gums lying within proposed development areas.

A network of public open space woodland habitat nodes and links containing most (and preferably all) the River Red Gums should be designed within proposed development areas. River Red Gums should be retained where possible. Given the likely role of the site as a habitat link to adjacent sites, the movement of fauna is dependent on retaining the remnant River Red Gums and patches of native grassland and shrubland.

Proposed public open space. At least 5% of land zoned Residential is incorporated as public open space. This should be managed for nature conservation as well as recreational utility. It should be the land containing the most significant vegetation. These areas should be protected during residential development.

 Other Issues

Weed invasion of grassland as a result of poor land-use.

Since the early 1990s livestock had been excluded from River Red Gum grassy woodland south of McDonalds Road. Dense stands of alien grasses and weeds such as Toowoomba Canary-grass, Yorkshire Fog, Sweet Vernal-grass, Chilean Needle-grass, Serrated Tussock, Paspalum and Ox-tongue developed in areas which, under light grazing, maintained Kangaroo Grass. These areas are pending residential development. A similar situation developed at Laverton North Grassland Reserve after stock were removed in the late 1970s. This is due to years of farm management practices favouring alien species such as excessive levels of fertiliser application and livestock grazing. These practices have caused ground compaction, selective loss in cover and diversity of native grasses and herbs and accumulations of phosphate and nitrate nutrient pools.

Monitored grazing regime to prevent weed 'blowouts'.

The spread of alien grasses and weeds in ungrazed grassland in pending residential development areas and possible recoveries of vigorous native grasses such as Kangaroo Grass should be monitored. This would provide useful application for grazing exclusion plot management and prescribed grazing regimes in Plenty Gorge Park to the east (Yarrambat–Morang Wetlands site) and the Red Gum Protection Zone to the north (Fenwick and Surrounds site). There has been an alien species 'blowout' in the absence of grazing. This presents a considerable fire hazard and low native grassland species diversity.

Reduced grazing levels but not total exclusion. A phased reduction of livestock grazing may be more successful. This would provide a less competitive environment for native grass and inter-tussock herb species and greater potential for their effective recolonisation.

Speed limit along a section of Plenty Road.

A speed limit of 75 km/hour should be introduced along Plenty Road between Gordons Lane and Hunters Lane as this is a point frequently crossed by wildlife. Signs advising the crossing of native mammals should be erected.

Implementation of Native Vegetation Clearance Controls. These should restrict rock removal, land clearing, cultivation and excessive grazing of significant wetland and grassland habitat.

Site 20 Quarry Hill

Map Reference:	7922 287345 (Quarry Hill). One minute lat/long grids include 37° 36' x 145° 03' to 145° 05' and 37° 37' x 145° 03' to 145° 04'.
Location/Size:	Quarry Hill, situated between McDonalds Road and Bridge Inn Road, north-east Epping. Approximately 1000 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: the summit of Quarry Hill is Proposed Public Open Space (MPE 1990); Department of Defence radio station on McArthurs Road. Private: remainder of site. Sheep and cattle farmlets on the western, northern and eastern flanks of the hill. Residential areas encroach from the south-west at Epping and south-east at South Morang. There is a clay quarry owned by Boral in the south-west.
Landforms:	Foothill, volcanic plain and alluvial plain (see PLVP B). Elevation is 160–272 m.

Natural Heritage Values

Landscape. Quarry Hill is the only sizeable granitic outcrop outside the ranges in NEM. Gellibrand Hill, 18 km to the west in WM, is a similar formation. Foothill granodiorite outcrops are restricted, isolated and heavily modified from land settlement clearing and quarrying in the lowland volcanic plains of GM. The landscape and biota has overlapping elements from foothill and volcanic plain.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Partially intact or small stands: Yellow Box–Red Stringybark–Hill Manna Gum box–stringybark woodland (11.2); River Red Gum (alluvial plain) grassy woodland (14.3; Regent Street/Hunters Lane); Drooping Sheoke–Black Wattle granite hills woodland (29.1)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); River Red Gum (drainage line) grassy woodland (14.4; degraded gullies on the southern side of Quarry Hill such as the north end of Gordons Road); Yellow Box–Candlebark grassy woodland (14.6; valleys including north end of Gordons Road); Rush Sedge–Common Spike-sedge (alluvial plain) seasonal wetland (25.1; eliminated from Mernda swamp)

Endangered, vulnerable or rare species: unsurveyed; potential for species such as the Slender Tick-trefoil in the rock crevices

Notable features: it is essential to protect the granite hills woodland between the McArthurs Road defence land and the north end of Gordons Road (Junors) as none remains elsewhere in NEM. The granodiorite tors support both Black and Drooping Sheoke and a diverse assemblage of ferns (e.g. Green Rock Fern, Narrow Rock Fern, Common Maidenhair, Blanket Fern, Sickle Fern and Necklace Fern). Tree Banksia persisted amongst the tors until the 1930s. The grassy woodland and granite hills woodland contain species characteristic of the volcanic plains. The box–stringybark woodland has biotic affinity with the foothills.

FAUNAL SIGNIFICANCE: Site 20 Quarry Hill

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

20^a: 37° 36' x 145° 04'; Sackville Street/northern flank of Quarry Hill

20^b: 37° 37' x 145° 04'; Hunters Lane, McArthurs Road to Gordons Road

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 20^b: Common Dunnart

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 20^a: 8 species including the Australian Shelduck and Black Swan in a flooded section of Mernda swamp along Bridge Inn Road east of Sackville Street on 1 May 1989

k. Frogs

Regional. 20^b: 6 species including the Bibron's Toadlet in the Hunters Lane to McArthurs Road section of Quarry Hill on 5 March 1990

l. Reptiles

Regional. 20^b: 9 species including the Marbled Gecko, Large Striped Skink, Cunningham's Skink and Bougainville's Skink in a 3-hour search of the Gordons Road north section of Quarry Hill on 11 October 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 20^a: over 100 species

b. Native birds

Regional. 20^a: over 90 species

c. Native mammals

Local. 20^a: 5 species; no mammal trapping was undertaken in the site

d. Herpetofauna

Regional. 20^b: 18 species

f. Butterflies

Unranked. 20^b: unsurveyed but a likely hill-topping area for significant Lycaenid species (e.g. azures and ant-blues) from surrounding plains and the Plenty Gorge

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 20^b: 7 species. **20^a:** 6 species

c. Regionally vulnerable fauna (R2 species)

Regional. 20^b: 3 species. **Birds:** Blue-winged Parrot, Southern Whiteface. **Mammals:** Common Dunnart

Regional. 20^a: 1 species. **Birds:** Brown Treecreeper

d. Regionally rare fauna (R3 species)

Regional. 20^a: 2 species. **Birds:** Collared Sparrowhawk, Little Corella

Regional. 20^b: 2 species. **Reptiles:** Marbled Gecko, Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

Regional. 20^a: 3 species. **Birds:** Australian King-Parrot, Rainbow Bee-eater. **Reptiles:** Red-bellied Black Snake

Regional. 20^b: 2 species. **Birds:** Speckled Warbler. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 20^a: 13 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Australian Shelduck, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Spiny-cheeked Honeyeater, White-winged Chough. **Reptiles:** Common Long-necked Tortoise

Regional. 20^b: 8 species. **Birds:** Little Lorikeet, Spiny-cheeked Honeyeater. **Reptiles:** Cunningham's Skink, Large Striped Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

g. Nesting birds of prey/parrots

Regional. 20^a: Wedge-tailed Eagles have bred for several years in an undisclosed section of Quarry Hill

F. POPULATION DENSITY: Viability and Abundance—point census

I. Regionally vulnerable fauna (R2 species)

Regional. 20^b: 20 Blue-winged Parrots amongst the Gordons Road tors on 9 April 1992

Outlook

Unless concerted conservation management is undertaken the faunal significance will decline from Regional Category 1 to Category 2 due to external severance of habitat links by urban expansion and an inability of the fauna in the habitat refugia to cope with escalating human induced impact/disturbance.

FAUNA

Rare or Threatened Fauna

Bc **20^b: Common Dunnart.** One was located under a log in Yellow Box–Red Stringybark–Hill Manna Gum box–stringybark woodland (11.2) near the Hunters Lane gravel pits on 5 March 1990. The range of the Common Dunnart and Fat-tailed Dunnart meet at Quarry Hill. The former species inhabits the granitic and sedimentary soils under box–stringybark woodland and rocky outcrop shrubland. The latter species inhabits crumbling red-brown soils of basalt stony knoll grassland near Darebin Creek in the Epping to Wollert site.

Other Significant Fauna

Birds

Ec **20^b: Blue-winged Parrot.** They are non-breeding autumn visitors to Quarry Hill. A flock of about 20 was seen in Drooping Sheoke–Black Wattle granite hills woodland (29.1) at the north end of Gordons Road on 9 April 1992. They were feeding from the ground amongst fallen seeds of Spear Thistle, Slender Thistle and Patterson’s Curse. They were also taking unspent seed from the dead thistles by using their claws to pull down the seed heads.

Ec **20^b: Southern Whiteface in sheokes.** The remnant Drooping Sheoke–Black Wattle granite hills woodland (29.1) of the granodiorite tors between McArthurs Road and the north end of Gordons Road supports a small population of Southern Whitefaces. This is the last known population on the Plenty Volcanic Plains. Three birds were seen south of the McArthurs Road radio station on 5 March 1990. A large grass-dome nest, probably of the whiteface, was in an upright branch of a nearby Drooping Sheoke. Whitefaces likely move into Yellow Box–Hill Manna Gum box–stringybark woodland (11.2) on the nearby sandstone hill-crests and hill-slopes to the north-west. Whitefaces feed on seeds and insects taken from the ground under tall shrubs (e.g. sheokes and Black Wattles) and probe for invertebrates under the bark of branches, trunks and fallen limbs.

Ef **20^{ab}: Spiny-checked Honeyeater.** The honeyeaters arrive from their coastal shrubland breeding grounds in late summer–early autumn. Several birds were seen on 5 March 1990 in Drooping Sheoke–Black Wattle granite hills woodland (29.1) of the granodiorite tors west of the end of McArthurs Road. They were taking the ripening fruit of Tree Violet and Box Mistletoe and the introduced African Box-thorn. Nectar is also taken from tall shrubs such as Tree Bursaria and mistletoes. Tree Banksia and Rock Correa, which are now extinct at Quarry Hill, would have been important nectar sources.

The honeyeaters glean foliage insects and probe for spiders under the shedding bark of dead branches or branch crevices. They sit on the top of bushes frequently during the day, giving their flute-like call. They occasionally hawk insects after sallies from these perches. They were also seen taking exuding gum (caused by insect damage) from the trunks of Black Wattles. Birds occasionally visit winter-flowering grevilleas and banksias in farm and house gardens surrounding Quarry Hill (Thelma Heddle pers. comm.).

Ef **20^a: Purple-crowned and Little Lorikeet.** The lorikeets arrive sporadically for flowering episodes of local eucalypts, sometimes in a substantial irruption with Musk Lorikeets. One of these was in River Red Gum

(alluvial plain) grassy woodland (14.3) along Hunters Road and Regent Street in mid-December 1991. The Little Lorikeet has been recorded breeding locally.

20^a: Bird lists of local residents. Most of the avifauna data was obtained by Linda Elliott and Thelma Heddle who are long-term residents of Sackville Street. Eleven species of parrots (not counting three lorikeets which were seen in this study; see *Ef*) were recorded in farmland and Yellow Box–Hill Manna Gum box–stringybark woodland (11.2) on the northern hill-slopes of Quarry Hill. Remnant trees are large and old and contain nest-hollows for species such the Red-rumped Parrot, which is locally common. The Gang-gang Cockatoo, Australian King-Parrot and Crimson Rosella are non-breeding autumn–winter visitors, probably from their spring–summer breeding grounds in the Plenty River headwaters.

The Rainbow Bee-eater occasionally visits in small numbers. White-backed Swallows were seen near the Hunters Lane gravel pits in the 1982–83 drought (Thelma Heddle pers. comm.). They probably still occasionally visit the area and possibly breed along with the bee-eater in gravel gullies on the hill-slopes of Quarry Hill. The Brown Treecreeper was recorded at Sackville Street on one occasion. They were formerly resident, but had declined to be vagrant by the late 1980s. They are now probably extinct on the volcanic plains and in the lowland hills.

Sixteen species of waterbirds were recorded on the bird lists. This diversity is influenced by the proximity of the Plenty Gorge Park Morang Wetlands, Yan Yean swamps and Yan Yean Reservoir.

20^a: Major Mitchell Cockatoo and Cockatiel. Small flocks were present during the 1982–83 drought in the Yellow Box–Hill Manna Gum box–stringybark woodland (11.2) of Quarry Hill and River Red Gum (volcanic plain) grassy woodland (14.1) on adjoining sections of the Plenty Volcanic Plains (Thelma Heddle pers. comm.). The cockatoo is an inland drought vagrant, but the Cockatiel is a rare breeding migrant (see site 18).

20^a: Regionally extinct Bush Stone-curlew and Grey-crowned Babbler from Quarry Hill. Both bird species were present in River Red Gum grassy woodland (14.1) on the volcanic plains toward Wollert until the 1930s (Evelyn Draper pers. comm.). They also inhabited Yellow Box–Hill Manna Gum box–stringybark woodland (11.2) and Drooping Sheoke granite hills woodland (29.1) at Quarry Hill. Extensive stands of sheoke and wattle were cut for boiler, kiln and oven fuel during the late Nineteenth and early Twentieth Century and the Great Depression. Golden Wattle and Lightwood were also cut for tan bark during this period. These episodes in tandem with livestock grazing eliminated nesting and feeding habitat of the babbler.

A decline in native prey (e.g. beetles and native bees) due to canopy loss, degradation of grassland and chemical poisoning was a likely cause in the regional extinction of both species. Lack of regeneration and tree decline of River Red Gums in rural areas due to clearing and grazing would have also been limiting factors. The babbler and curlew have declined throughout their range in Victoria due to loss of habitat and other factors such as predation from foxes and cats.

20^a: Regionally extinct Cape Barren Goose. Until the mid-1950s, small flocks visited the Mernda swamp at the north-east foot of Quarry Hill (Thelma Heddle pers. comm.). The swamp lies between Cravens Road and Sackville Street. The Cape Barren Goose breeds on Bass Strait islands. It formerly spent the summer and autumn on the flooded marshes of creeks and open plains near Melbourne (Wheelwright 1862). After rains it would appear in this district to feed on new shoots of aquatic grasses in seasonal marshes.

Mammals

20^{ab}: Remnant foothill ground marsupials. The remnant box–stringybark woodland of the hill-slopes and gullies provides a refuge for several foothill species which are now restricted on the plains. These include the Common Wombat and Black Wallaby.

Reptiles

Ed **20^a: Marbled Gecko and Eastern Small-eyed Snake.** Both were recorded in crevices of granodiorite amongst Drooping Sheoke–Black Wattle granite hills woodland (29.1) at the north end of Gordons Road. The gecko was observed on 11 October 1988 while the small-eyed snake was observed on 5 October 1988. Both are nocturnal species. The Eastern Small-eyed Snake is relatively common nearby in the Plenty Gorge but is absent

from the volcanic plains west of Quarry Hill. The nearest granitic outcrop populations are at Gellibrand Hill, 18 km to the west.

Ef **20^b: Cunningham's Skink, Large Striped Skink, Bougainville's Skink, Tussock Skink and Little Whip Snake.** These regionally restricted species are characteristic of the Quaternary volcanic plains. They also occur on Quaternary volcanic (basalt) cones and Devonian granite outcrops on the volcanic plains of central Victoria (e.g. You Yangs). Nine reptile species were recorded during a three-hour search of granitic tors amongst Drooping Sheoke–Black Wattle granite hills woodland (29.1) at the north end of Gordons Road on 11 October 1988.

Two Little Whip Snakes were recorded under granodiorite boulders. Another three had been seen nearby on 5 October 1988. The whip snake is related to the Eastern Small-eyed Snake. They occupy similar niches (diet and cover) and, unless in granite, do not normally co-exist. Rock outcrops were important for the Cunningham's Skink and Bougainville's Skink, while grasslands supported the Large Striped Skink and Tussock Skink.

There is a diverse reptile assemblage at Quarry Hill due to overlapping occurrences of species from volcanic plains grassland and foothill box–stringybark woodland. Logs in association with Yellow Box–Hill Manna Gum box–stringybark woodland (11.2) are important for the Tree Dragon. This foothill species does not occur on the volcanic plains west of Quarry Hill.

Frogs

Ee/Ef **20^b: Bibron's Toadlet and Common Spadefoot Toad.** Both occur in burrows in old granitic sand pits surrounded by Drooping Sheoke–Black Wattle granite hills woodland (29.1). The toadlet was located west of the end of McArthurs Road on 5 March 1990. The toad was located under a piece of granodiorite at the north end of Gordons Road on 9 April 1992.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Severe habitat loss and degradation from high impact land use. Since settlement, Quarry Hill has been subjected to high impact land uses such as clearing, intensive grazing and quarrying. The sheoke was cut out or razed by bushfires and sheep and rabbits eliminated the regrowth. The cleared granite tors of the western summit (near the trig point) provide a desolate landscape.</p> <p>The site is becoming increasingly degraded from livestock and rabbit grazing, rock removal and weed invasion. Shrubby weeds including Gorse, Sweet Briar, African Box-thorn and Montpellier Broom are now abundant where sheoke and banksia groves once flourished. The herb layer is dominated by an unproductive (for livestock and most native animals) growth of thistles, Patterson's Curse, Chilean Needle-grass and Cape Weed. In several areas the noxious alien shrubs and annual weeds are all that remain. The loose granitic soils have eroded under the grazing pressure. Box-thorn harbours rabbits but provides cover for some species of native birds.</p> <p>Fragmentation of habitat links by residential encroachment and farmlets. In addition to the preceding scenario, habitat links previously fragmented by rural settlement are now being severed by urban settlement. The southern, western and eastern flanks of Quarry Hill are undergoing urban expansion in the growth corridor north of Mill Park–Blossom Park and incremental growth from Epping. Farmlet subdivisions are proliferating, accompanied by River Red Gum decline and basalt rock removal. The red gum woodland and volcanic plains ground fauna assemblages are now locally threatened. Loss of habitat on the surrounding plains has isolated populations of ground fauna species at Quarry Hill. This has led to local faunal extinctions.</p>	<p>Habitat connectivity. There are fragmented habitat links to the Epping to Wollert site and Yarrambat–Morang Wetlands site. Links to the Plenty Gorge will likely be severed by future urban development as has recently occurred between Quarry Hill and Mill Park. Prior to land clearing, the site may have had considerable importance for birds migrating from the inland or undertaking seasonal movements between the uplands and lowlands, comparable to the role of the You Yangs with the Brisbane Ranges and Werribee Plains.</p> <p>Strengthen habitat links. External links to permit the movement of fauna to the Plenty Gorge through the growing residential area between South Morang and Mernda need to be restored.</p> <p>Conservation management plan for rehabilitation and land protection works. Preparation of a conservation management plan is recommended for Quarry Hill. Significant stands of Yellow Box–Hill Manna Gum box–stringybark woodland and Drooping Sheoke–Black Wattle rocky outcrop shrubland need to be surveyed and identified. They require protection and enhancement works. Removing livestock from sections would enable regeneration and replanting. Programs are needed for soil erosion, weed and vermin (e.g. rabbit) control and revegetation. Species such as sheokes and ferns that are sensitive to grazing need protection from livestock and rabbits. Restrictions on further removal of granodiorite would benefit the rehabilitation process.</p>

Restriction of ground fauna movement—local fauna extinctions and road-killed wildlife.

Plenty Road has restricted the movement of ground fauna from the Plenty Gorge. Road-killed Common Wombats, Eastern Grey Kangaroos and Black Wallabies have been observed along Plenty Road at the nearest point of approach of the two units in the Wilton Vale Road area.

Impact of sand and gravel quarries—high erosion and weed hazard. The extensive quarrying of granitic sands, gravel and granodiorite in the east section of Quarry Hill was not accompanied by any land protection measures during the operations or post-operation restoration works. As well as being a weedy wasteland, the old quarries have become a major soil erosion hazard. Areas of exposed granodiorite are still being removed and the landscape at Quarry Hill is in the process of being eliminated.

Implementation of Native Vegetation

Clearance Controls on private land. The controls should contain restrictions on rock removal, land clearing, cultivation and excessive grazing of significant woodland, shrubland and grassland habitat. Earthwork in granitic areas is a high land hazard operation. All future operations should be subject to strict permit applications which address land rehabilitation.

Other Issues

Acquisition/conservation management of PPOS. Areas of Proposed Public Open Space (PPOS) occur at Quarry Hill (MPE 1990). Urgent attention on land protection, conservation and sustainable land management practices is required in these areas.

Grazing by rabbits and livestock. The ferns and low shrubs (e.g. Clustered Everlasting, Cranberry Heath, Running Postman and Gold-dust Wattle) are heavily grazed. Some of the ferns (e.g. Blanket Fern) are reduced to a few plants in inaccessible crevices in the granitic tors. Some of the shrubs remain only in areas protected from livestock grazing such as roadsides.

Rabbit, fox and weed control. Culling of the high populations of rabbits and foxes present is necessary. Laying strychnine or 1080 baits for foxes and dogs must be avoided as Quarry Hill supports one of the last breeding pair of Wedge-tailed Eagles within 25 km of Melbourne's CBD. Rabbit warrens should be fumigated, contour-ripped and resown to native grasses. Infestations of Gorse, Boneseed and Montpellier Broom require immediate attention. African Box-thorn should be poisoned but not removed until cover from replanted native shrubs has established.

PLVP C DAREBIN CREEK DAREBIN TO BUNDOORA

This management unit consists of four sites of regional faunal significance (sites 21, 22, 23 and 24).

Map Reference: 7922 269167 to 7922 292274 (Darebin Creek).

Location/Size: The Darebin Creek and adjacent open space from Heidelberg Road Darebin to McKimmies Road Bundoora. Approximately 750 ha.

Municipality: Cities of Whittlesea (upstream of Settlement Road), Darebin (downstream of Settlement Road) and Banyule (east side of Darebin Creek downstream of Northern Road).

Physical Features

The management unit lies on the volcanic plains of the Eastern Uplands where it meets the Yarra Alluvial Plains to the south-east (e.g. La Trobe University and Yarra River). Darebin Creek comes into contact with the western margin of the alluvial plains at Bundoora. It remains on the lava plains until striking the alluvial plains at Donaldsons Creek Ivanhoe, after which the lava flow boundary follows the western escarpment until the floodplain of the Yarra River.

Landforms

Alluvial plain: plain-slopes (RMIT Bundoora and east of creek at Darebin Parklands), sandstone escarpment (Darebin Parklands) and sand-plain (RMIT and Bundoora Park). Volcanic plain: Tertiary cappings (RMIT) and Quaternary cone (Mt Cooper), stony crests, stony plains, gilgai plains, swales, narrow creek gorge/terrace floodplains, drainage lines, artificial lakes and a large quarry. Elevation is 20–120 m (Mt Cooper).

Hydrology

Upstream of Settlement Road, Darebin Creek flows about nine months of the year and contains sections of columnar basalt cliffs, shallow cobble and sandy riffles, rocky reefs with tessellated pavements and shallow pools lined with reeds. Summer flow is mostly stormwater runoff from residential areas. The section downstream of Norris Bank is a stormwater drain with culverts, straightened and channelled for flood control.

A shallow waterbody covering 2–3 ha during winter–spring occurs on the deepest sections of the BMG Quarry. This dries to small pools in summer. Artificial lakes and wetlands are present on Bundoora Park and Bundoora Public Golf Course and along Strathallan Creek floodplain to the south of Kingsbury Drive at La Trobe University.

Between La Trobe University and Darebin Parklands the creek has a narrow gorge and the flow is perennial, supplemented by urban runoff. This section of the creek contains columnar basalt cliffs, tessellated basalt pavements and pools up to 1.5 m deep lined with reeds. On striking the sandstone at Donaldsons Creek (Darebin Parklands), the creek bed is composed of sedimentary reefs, rock pools and cascades while sandstone cliffs occur on the east side.

The valley meanders and broadens in the centre of Darebin Parklands with a floodplain downstream of the footbridge on the Banyule side and terraces below a broad volcanic spur (Mulberry Spur) upstream of the footbridge on the Darebin side. A floodwater retarding basin has been constructed in the creek in the downstream section of Darebin Parklands. Artificial wetlands include the Separation Street tip pondage and a terrace swamp excavated on the east side of the creek below Pine Ridge.

Ephemeral drainage lines in the Bundoora to Alphington section have been barrel-drained. Two remain in the upstream section of the unit. The larger of these rises from the back of RMIT Bundoora Campus while a local drainage line runs through the south-east corner of nearby BMG quarry land. The paddocks to the east of the creek in this section are low-lying and support degraded seasonal freshwater meadows.

Rainfall: 630–650 mm.

Site 21 BMG Quarry–Howy’s

Map Reference:	7922 282267 to 7922 292274 (Darebin Creek); 7922 272273 (BMG Quarry); 7922 270270 (mid-point of Howy’s). One minute lat/long grids include 37° 40' x 145° 02' to 145° 03' and 37° 41' x 145° 02' to 145° 03'.
Location/Size:	Darebin Creek from the Maroondah Aqueduct to McKimmies Road including Howy’s Land and the riparian section of Thomastown East Reserve on the west side of the creek and the BMG Quarry, west section of RMIT Bundoora Campus and vacant land lying to the south on the east side of the creek. Approximately 230 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: freeway reservation (Vic Roads); RMIT Bundoora Campus (State Training Board); creek frontage of Thomastown East Reserve (City of Whittlesea). Private: quarry (extractive, owned by BMG Quarries Ltd); remainder agistment properties and vacant land pending development.
Landforms:	Alluvial and volcanic plains (see PLVP C). Elevation is 70–100 m.

Natural Heritage Values

Landscape. The open space provides the most extensive and natural volcanic plains landscape remaining in Bundoora. The area near BMG Quarry has historical features such as stone walls erected by early settlers of Bundoora.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: River Red Gum (volcanic plain) grassy woodland (14.1); River Red Gum (drainage line) grassy woodland (14.4; Darebin Creek); Common Reed–Cumbungi seasonal wetland (25.7; BMG Quarry)

Remnant, degraded or establishing stands: River Red Gum (alluvial plain) grassy woodland (14.3; RMIT); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Brown-back Wallaby-grass seasonal wetland (25.3)

Endangered, vulnerable or rare species: unsurveyed; too disturbed to persist

Notable features: Howy’s Land contains the most extensive stand of River Red Gum grassy woodland in the urban section of Darebin Creek. The understorey is a mixture of disturbed weedy swards and some areas of Kangaroo Grass. There are small sections of stony knoll grassland and gilgai seasonal wetland on Howy’s and in paddocks south-west of RMIT. These are representatives of few remaining in the urban area.

FAUNAL SIGNIFICANCE: Site 21 BMG Quarry–Howy’s

Assessment: Regional—Category 2 (C, D, E, F)

Reference grids for the significance keys include:

21^a: 37° 41' x 145° 02'; BMG quarry/Howy’s Bundoora/Thomastown East Reserve

c. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 21^a: 14 species including 38 waterfowl at the BMG Quarry wetland on 14 September 1992

k. Frogs

Regional. 21^a: 7 species including the Bibron’s Toadlet on 5 March 1991

l. Reptiles

Regional. 21^a: 8 species including the Cunningham's Skink, Bougainville's Skink, Tussock Skink, Red-bellied Black Snake and Lowland Copperhead on 5 March 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 21^a: 99 species

b. Native birds

Regional. 21^a: 73 species

c. Native mammals

Local. 21^a: 5 species

d. Herpetofauna

Regional. 21^a: 21 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 21^a: 11 species

c. Regionally vulnerable fauna (R2 species)

Regional. 21^a: 2 species. **Birds:** Spotted Harrier. **Mammals:** Fat-tailed Dunnart

d. Regionally rare fauna (R3 species)

Regional. 21^a: 2 species. **Birds:** Australian Spotted Crake, Hardhead

e. Regionally depleted fauna (R4 species)

Regional. 21^a: 7 species. **Birds:** Latham's Snipe, Peregrine Falcon, Rainbow Bee-eater, White-winged Triller, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 21^a: 10 species. **Birds:** Brown Songlark, Singing Bushlark. **Reptiles:** Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

f. Frogs

Regional. 21^a: over 50 Growling Grass Frogs and Common Spadefoot Toads recorded at BMG Quarry on 5 March 1991

Outlook

The faunal significance could be raised from Regional Category 2 to Category 1 with habitat works, particularly with respect to wetland development and waterbird diversity at the BMG Quarry. Further habitat loss, degradation or fragmentation would lower it to Category 3. With external habitat links virtually severed by urban areas, conservation management and protection will be of critical importance to the continued viability of the grassland and grassy woodland ecosystems.

FAUNA

Other Significant Fauna

Birds

- Ec* **21^a: Spotted Harrier.** One was observed over Howy's on 5 March 1991. This is the nearest approach this plains species makes to the city. It was hunting over the grassland, presumably in search of Field Mice, reptiles or grassland birds.
- Ed* **21^a: Australian Spotted Crake, Hardhead and other waterbirds of the BMG Quarry.** The wetland supports waterfowl that are rare in the urban area. Fourteen species including 38 waterfowl were seen on 14 September 1992. Two Hardhead were present. Rarely recorded during the survey in the urban area, they were observed elsewhere in the district only at Tanunda Wetlands in Plenty Gorge Park. Two pair of Black-fronted Plovers were present and would breed on the shoreline. A Latham's Snipe (*Ee*) and an Australian Spotted Crake were seen in the reed-beds (25.7) of the drainage line to the south-east of the quarry. The area forms temporary, early spring feeding areas for cover-dependent waterbirds.
- Ee* **21^a: Peregrine Falcon.** Birds were recorded at BMG Quarry on both survey visits (5 March 1991 and 4 September 1992). An area of whitewash has been created by nesting raptors on a ledge below a cliff-face cavity on the western side of the quarry. It may be from nesting Peregrine Falcons. If this is the case, human disturbance near the western side of the quarry should be kept to a minimum during spring. Six bird of prey species were recorded for the site.
- Ee* **21^a: Rainbow Bee-eater, White-winged Triller and Rufous Songlark—migratory insectivores.** Six bee-eaters including several juveniles, were seen on Howy's on 5 March 1991. Burrows were located in the creek escarpment. The species has been eliminated from nearer urban sections of the creek. A pair each of the triller and songlark were present in River Red Gum grassy woodland (14.1) at Howy's on 14 September 1992. Both of these migrants were preparing to breed.
- 21^a: Marshland passerines in the reed-beds of BMG Quarry.** The reed-beds along the drainage line to the south-east of the quarry wetland contained nesting Little Grassbirds, Clamorous Reed-Warblers and Golden-headed Cisticolas on 14 September 1992. Twenty White-fronted Chats were counted in African Box-thorn thickets between the drainage line and the quarry wetland. One pair had commenced nesting.
- 21^a: Insectivores of the River Red Gum woodlands on Howy's.** Dieback caused by excessive populations of foliage insects and deficient numbers of foliage birds is a major problem throughout fragmented stands of grassy woodland in NEM. Several trees with noticeable dieback were present in the River Red Gum grassy woodland (14.1) on Howy's. Small populations of locally uncommon breeding foliage birds were recorded on 14 September 1992. These included the Fan-tailed Cuckoo, Grey Shrike-thrush, White-winged Triller, Rufous Songlark, Spotted Pardalote and Striated Pardalote. Other cuckoos including the Pallid Cuckoo and Horsefield's Bronze-Cuckoo were also present.

A Sacred Kingfisher was present on 5 March 1991, probably having bred locally in a River Red Gum hollow. Planting additional River Red Gums and tall shrubs including Black Wattle, Golden Wattle and Sweet Bursaria would benefit each of these species. It would also improve the health of the River Red Gums.

Mammals

- Ec* **21^a: Fat-tailed Dunnart.** One was located under a rock amongst crumbling brown soil in Kangaroo Grass stony knoll grassland (22.1) behind La Trobe Village. The species would only sparingly occur on the rocky escarpments and stony knolls.
- 21^a: Echidna.** The population is the innermost remaining along Darebin Creek.

Reptiles

Ee/Ef **21^a: BMG Quarry/Howy's.** Areas of Kangaroo Grass stony knoll grassland (22.1) and some of the ground fauna species are near their downstream limits along the Darebin Creek system. The reptile assemblage is the most diverse in the urban section of Darebin Creek. Regionally depleted species (*Ee*) include the Red-bellied Black Snake, while regionally restricted species (*Ef*) include the Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink and Little Whip Snake. Stony knoll grassland and volcanic creek escarpment shrubland (20.5) and their fauna are locally threatened as they are dependent on maintenance/enhancement of a habitat link upstream along the creek. The Lowland Copperhead and Red-bellied Black Snake were both recorded in River Red Gum grassy woodland (14.4) along the creek on 5 March 1991. The Common Long-necked Tortoise is found in pools along the creek.

The volcanic creek escarpment shrubland and stony knoll grassland sections of BMG Quarry and Howy's support the range of expected species, including viable populations of the Bougainville's Skink and Tussock Skink. Several species, including the Large Striped Skink, Cunningham's Skink, Southern Water Skink, Little Whip Snake, Lowland Copperhead and Red-bellied Black Snake, are rare. Continued unfavourable management leading to habitat degradation or further loss of habitat may eliminate them. Each is rare or absent from grassland remnants in suburban areas. They have been virtually eliminated from inner sections of Darebin Creek in the last decade.

Frogs

Ee/Ef **21^a: BMG Quarry/Howy's.** Nine species have been recorded. The quarry wetland and adjacent pools of Darebin Creek contain substantial populations of Growling Grass Frogs and Striped Marsh Frogs (*Ef*). The dams and freshwater meadows are important for Common Spadefoot Toads (*Ef*). Each species has become scarce along inner sections of the creek. The regionally depleted Bibrons Toadlet (*Ee*) occurs in freshwater meadows on Howy's.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. No intact habitat links remain.	
<p>Loss and fragmentation of native grassland and grassy woodland habitats. Native vegetation in bordering areas of the site has been eliminated by urban development and much of that occurring within the site has been degraded by past and continuing land-use. The viability of many species and the overall grassland and grassy woodland ecosystems is declining. The grasslands of the plains and escarpments are heavily weed invaded.</p> <p>Defoliation and dieback of River Red Gums. Stands of River Red Gum are fragmented and are undergoing excessive defoliation rate and dieback (see Volume 1).</p> <p>Severance of external habitat links. This may ultimately lead to the elimination of several significant ground fauna species including the Fat-tailed Dunnart, Lowland Copperhead and Large Striped Skink.</p>	<p>Revegetation and conservation management of Howy's land. The area would benefit from conservation works such as weed control and indigenous tree and shrub plantings. The western end of Howy's near existing commercial/industrial development at Thomastown has lower grassland conservation values and is dominated by Chilean Needle-grass, brome grasses and Yorkshire Fog. The basalt rocks have been surface stripped and few herpetofauna species were located. Important grassland, seasonal wetland and grassy woodland areas lie nearer the creek in the east of the block. These should be identified and managed as a conservation area. Extensive revegetation of trees and shrubs should be undertaken. A controlled activity complex of horse and bike trails and jumps should be devised for Howy's. Regeneration of stands of River Red Gum grassy woodland is necessary.</p> <p>Strengthen habitat links. The establishment of effective external habitat links along the creek is considered critical to the continued viability of faunal populations. Riparian links both upstream and downstream need to be protected and enhanced in accordance with the Regional Habitat Link Strategy. There are significant species and habitats present and the establishment of fuller links will promote their long-term viability, which is currently threatened. Extensive weed control and replanting of indigenous vegetation along the creek is required both internal and external to the site. The site should be established as a link to downstream sites which are identified as 'green web' areas. Maintenance and protection of the BMG Quarry–Howy's site will be necessary if avifauna populations in the highly fragmented downstream sites are to remain viable.</p>

 Regional Hydrological Strategy

Reduction of water quality and habitat of the creek and elimination of instream and riparian fauna. Several riparian fauna species such as the Rainbow Bee-eater and Red-bellied Black Snake are in the process of elimination. Declining water quality of the creek is affecting the bee-eaters. A substantial component of their insect food has aquatic larval stages. Most native fish, apart from eels which are tolerant of low water quality conditions, appear to have been eliminated. The native escarpment vegetation is in substantial decline. The escarpment and stony knoll shrublands have died or been burnt out by livestock grazing and frequent grassfires, being replaced by Gorse and Montpellier Broom. Most of the old River Red Gums along the creek have died, without replacements.

Reduced rate of natural flow in Darebin Creek. Darebin Creek's natural flow rate is decreasing and that attributable to urban runoff is increasing. Reduction in natural flow is the combined result of farm dam proliferation and clearing of catchment woodlands.

Revegetation and conservation management of Darebin Creek. Sections of fair quality habitat (both instream and escarpment) occur along the creek. This offers greater potential for restoration than the downstream Bundoora Park site which has undergone creek 'improvements' such as straightening and the removal of rock barriers to facilitate stormwater flow. Substrate damage from livestock, particularly cattle, is more evident along the creek in the BMG Quarry–Howy's site. This will need control if grazing is to continue. Fencing will be required to prevent stock access to the creek. Gorse and Montpellier Broom on the creek escarpment need to be controlled.

Establishment of water quality controls and guidelines for Darebin Creek. Water quality studies should be conducted to determine the effect of damming, quarrying and catchment land-use. A hydrological strategy should be formulated for the creek with the aim of restoring natural aquatic ecosystems. Methods to improve the water quality input from upstream sources should be reviewed.

 Other Issues

Uncontrolled, non-passive recreational activities. Sections of Howy's adjacent to the Thomastown East Reserve are heavily used by trail, push-bike and horse riders. The current lack of adequate conservation management and uncontrolled levels of public use are eroding the flora and faunal values.

Fox and rabbit populations. High densities of foxes and rabbits occur in the Gorse along Darebin Creek and at BMG Quarry.

Weed invasion of the BMG Quarry land. Cliffs of the quarry wetland contain Gorse, Spanish Artichoke, Fennel, Serrated Tussock and Spear Thistle. Areas of Montpellier Broom, Toowoomba Canary-grass and Chilean Needle-grass fringe the stony surrounds of the drainage line meadows south-east of the quarry wetland. The broom has been encouraged by earthworks and the high frequency of fires in the area. A fire in summer 1991–92 killed some of the plantation eucalypts at the south-eastern perimeter of the quarry land (see below for conservation suggestions).

 Conservation Measures for BMG Quarry

Require a conservation management plan. Major issues that should be addressed are the formulation of guidelines to reduce pest species populations and a wetland restoration plan. The wetland plan should address the establishment of a diverse and functional wetland system and its role in the regional wetlands complex. Plans should be drawn up for the design of visitor facilities at the quarry. Consideration of low conflict locations with fauna and flora and controls on visitor use capacity and public safety aspects will be critical.

Acquisition and wetland development. The working life of the quarry is near completion. It should be acquired as public open space and established as a wetland conservation area since the immediate area is devoid of a nature conservation utility available to the public. The quarry wetland contains shallow water and muddy/rocky shorelines which are starting to develop invertebrate prey populations for waders and aquatic herbfields for waterfowl. The quarry floor has a diverse topography. Piles of basalt boulders presently above the high water mark have potential for roosting areas.

The waterbody will deepen by over a metre in coming years and create a larger, more permanent wetland. An additional 2 to 3 ha of the floor would be flooded, including the stranded rock piles, creating a relatively large and rather significant wetland of about 6 ha. There is potential for this wetland to support over a hundred waterfowl, making it at least of equal importance to some of the Plenty Gorge quarry wetlands. An additional waterbody attracting this number of waterfowl would form a vital component in the seasonal movements and population viability of species in the context of the regional network of wetlands.

The drainage line emergent herbfield south-east of the main quarry needs to come under conservation management. Already an area for snipe and crakes, it could be improved.

Weed eradication program. Most of the dominant weeds on the quarry land are noxious and need to be controlled. They should be removed in conjunction with weeds on surrounding areas as these would provide a source for re-invasion.

Revegetation works on the drylands. Weed control along the cliffs of the quarry wetland should be accompanied by extensive shrub planting. Suitable species include Lightwood, Golden Wattle, Black Wattle, Drooping Sheoke and Tree Bursaria. Tree Banksia, which once grew on the escarpments of the creek, should also be grown and planted. Screening plantations established by the management on earth batters surrounding the quarry have attracted bushbirds back to the site (e.g. nest sites and feeding areas for New Holland Honeyeaters and Grey Fantails). Most of the plantation species are non-indigenous. The River Red Gums in the plantation have done better than the others and, along with Yellow Box, should be the species used in future plantings. The Red Box and Yellow Gum, in particular, have grown rather poorly on the basalt. The shrub layer is composed of several wattles which have the propensity to become environmental weeds (Early Black Wattle, Sallow Wattle and Gawler Range Wattle). As these die they should be replaced with indigenous species. Extensive shrub and herb layer plantings are required. Kangaroo Grass and Weeping Grass should be planted in rocky areas.

Wetland revegetation works and the attraction of waterbirds. See also the Bundoora Park, La Trobe University Campus Wildlife Reserves, Tanunda Wetlands and Yarrambat–Morang Wetlands sites. Soil should be placed in sections of the rocky shallows and the planting of emergent aquatics such as Tall Spike-sedge and River Club-sedge. This might attract some rare cover-dependent waders such as rails, crakes and bitterns. Submerged meadow species including Amphibious Milfoil, Floating Pondweed, Floating Club-sedge, Lake Eel-grass and Blunt Pondweed should be established to attract more waterfowl, Dusky Moorhens and Purple Swamphens.

Planting tall shrubs such as Swamp Paperbark along the edges would provide cover and breeding habitat for waterbirds and marshland passerine birds. Planting River Red Gums near the water edge and placing logs, branch debris and fallen trees in the shallows and at the edges would also provide feeding habitat and cover for waterbirds, frogs, tortoises and detritus invertebrates such as the micro-crustacea, which are important for waders. This would start the nutrient turnover and the development of habitat for other substrate invertebrates, which form important prey for waterbirds. At this point the waterbody could be stocked with native fish, including the Southern Pigmy Perch, to attract waterbirds such as herons, cormorants and pelicans. Veined Swamp Wallaby-grass and Common Spike-sedge should be established in the low-lying meadows at the base of the cliffs. This would provide important habitat for frogs and high-water spawning and feeding areas for fish.

Potential for public use. As premium urban open space, controlled recreational venues in sections which have low impact on flora and fauna values could be established at Howy's. The BMG Quarry has high potential for controlled public use such as wetland education. The quarry has tiered levels and largely lacks substantial sheer drops. It is considered safer for public use than others in the district such as those in the Plenty Gorge Park. The perimeter of the quarry contains fewer sharp rocks and access is already available via a circumnavigating vehicle track. This could form the basis of a walking track and nature trail system. Interpretation facilities would be necessary as a means of raising local community awareness of conservation issues.

A community environmental group should form to assist in coordinating management activities and as a safeguard against vandalism. The local youths will need to be targeted for a fire education exercise in an attempt to restrict the outbreak of further fires in the area. Their recruitment into the conservation group might reduce the amount of vandalism. Wetland development at the quarry would provide a broad diversity of habitats and waterbirds. There are excellent viewing points on the south-east side from which disturbance to waterbirds created by the presence of humans could be kept to a low level. Screen and shelter plantings should be undertaken near these vantages with a view to establishing bird hides.

Site 22 Bundoora Park

Map Reference:	7922 262242 to 7922 276267 (Darebin Creek). 7922 269242 (Bundoora Park Conservation Area). One minute lat/long grids include 37° 42' x 145° 02'.
Location/Size:	Darebin Creek from Chenies Street to Holt Parade Bundoora including Bundoora Park. Approximately 180 ha.
Municipality:	City of Darebin.
Land Tenure/Use:	Public: Darebin Creek streamway (City of Darebin). Private: Bundoora Park (Bundoora Park Committee of Management).
Landforms:	Volcanic and alluvial plain (see PLVP C). Elevation is 70–120 m (Mt Cooper).

Natural Heritage Values

Landscape. The stand of River Red Gums at Bundoora Park along with that at La Trobe University provides the only extensive and relatively natural grassy woodland landscape remaining in the City of Darebin.

Scientific and Educational Values

Rehabilitation and management. A wildlife reserve and wetland area has been established at Bundoora Park. The south-western section of Bundoora Park is being managed as a Conservation Area. River Red Gums have been extensively planted along the fairways of Bundoora Public Golf Course.

Public interpretation. Bundoora Park offers potential for a range of nature conservation interpretation activities.

HABITAT SIGNIFICANCE:

Assessment: High—Category 2

Relatively intact and extensive stands: River Red Gum (volcanic plain) grassy woodland (14.1; Conservation Area); the stand is not extensive but the assessment is in the context of the regional rarity of stands with relatively intact understorey

Partially intact or small stands: Brown-back Wallaby-grass seasonal wetland (25.3); Common Reed-Cumbungi seasonal wetland (25.7)

Remnant, degraded or establishing stands: River Red Gum (alluvial plain) grassy woodland (14.3); River Red Gum (drainage line) grassy woodland (14.4; Darebin Creek); Lightwood-Tree Violet cliff/escarpment shrubland (20.5)

Vulnerable species: Matted Flax-lily (scattered plants in Conservation Area and on west side of Darebin Creek)

Rare species: Yarra Gum (couple of trees in the Plenty Road parkland)

Notable features: The stand of River Red Gum (volcanic plain) grassy woodland in the Conservation Area at Bundoora Park is one of the most intact in NEM. It is also the most extensive remaining in the urban area and one of few contained in a reserve. Due to pastoral history, the grassland is not as diverse as the Epping Cemetery stand but is less fragmented and more protected. It contains several regionally significant grassland species including Blue Grass-lily, Salmon Sun-orchid, Grassy Bindweed, Variable Glycine. It is of ecological interest as it lies on the leading edge of the Quaternary volcanics with Silurian formations to the east. There are small, intact areas of Brown-back Wallaby-grass (gilgai/swale) seasonal wetland in drainage line soaks. These contain several regionally significant plants including the Milky Beauty-heads.

FAUNAL SIGNIFICANCE: Site 22 Bundoora Park

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

22^a: 37° 42' x 145° 02'; Bundoora Park

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 22^a: single sighting of six Swift Parrots on 30 September 1991

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 22^a: 18 species on 28 February 1991

g. Nesting parrots

Regional. 22^a: 7 species including the Red-rumped Parrot, Crimson Rosella, Musk Lorikeet and Little Lorikeet during a 40-minute bird census on 30 September 1992

h. Bats

Regional. 22^a: 4 species on 28 February 1991

i. Frogs

Regional. 22^a: 7 species including the Growling Grass Frog and Common Spadefoot Toad from survey conducted between 28 February and 8 March 1991

j. Reptiles

Regional. 22^a: 7 species including the Tussock Skink, White's Skink, Delicate Skink and Eastern Brown Snake from a 3-hour search on 28 February 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 22^a: 110 species

b. Native birds

Regional. 22^a: 84 species

c. Native mammals

Regional. 22^a: 7 species

d. Herpetofauna

Regional. 22^a: 19 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 22^a: 7 species

d. Regionally rare fauna (R3 species)

Regional. 22^a: 2 species. **Birds**: Australian Spotted Crake. **Reptiles**: Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

Regional. 22^a: 5 species. **Birds**: Latham's Snipe, Swift Parrot, White-winged Triller, Rufous Songlark. **Reptiles**: White's Skink

f. Regionally restricted fauna (R5 species)

Regional. 22^a: 17 species. **Birds**: Nankeen Night Heron, Royal Spoonbill, Great Egret, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Spiny-cheeked

Honeyeater. **Reptiles:** Common Long-necked Tortoise, Cunningham's Skink, Delicate Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 22^a: 4 Latham's Snipe flushed from the Conservation Area on 30 September 1991

n. Regionally depleted fauna (R4 species)

Regional. 22^a: 6 Swift Parrots on 30 September 1991

Outlook

Habitat protection and enhancement works should improve the faunal significance, but may well be necessary to keep this from declining. With reduction of human and dog disturbance in the Conservation Area, there is potential to attract more Latham's Snipe. Internal habitat loss and severance of external habitat links has depleted reptile populations.

FAUNA

Rare or Threatened Fauna

Bb 22^a: Swift Parrot. Six birds were seen feeding on leaf psyllids and flower buds in River Red Gum (alluvial plain) grassy woodland (14.3) in the parkland at the front of Bundoora Park on 30 September 1991. The River Red Gums stretching east from Bundoora Park through La Trobe University and the psychiatric hospitals are an important late season (September/October) feeding area for Swift Parrots before they depart to their breeding grounds in Tasmania.

Other Significant Fauna

Birds

Cg 22^a: Nesting parrots in the River Red Gums. Seven species were observed breeding in hollows of River Red Gum (alluvial plain) grassy woodland (14.3) in the south-east section of Bundoora Park during a 40-minute bird count on 30 September 1991. Notable breeding records were the Little Lorikeet, Crimson Rosella (rarely recorded in the urban area) and Long-billed Corella (as preceding). An additional four non-breeding species were recorded, including small flocks of Rainbow and Purple-crowned Lorikeets, which were feeding in a blossoming Yellow Box, and Swift Parrots (see **Bc**). Purple-crowned Lorikeets are rarely sighted in urban parts of NEM.

Ed 22^a: Australian Spotted Crake and other waterbirds of the wildlife reserve lake. Eighteen species including 64 waterfowl were seen on 28 February 1991. Fifty of the waterfowl were Australian Wood Ducks. Large waders including three species of cormorants, three species of herons, two species of ibis and the Great Egret were present. A dead tree at the north end of the wetland is the major roost. An Australian Spotted Crake was seen on the shoreline amongst the Cumbungi emergent herbfield (25.7) at the southern end.

Ee 22^a: Latham's Snipe at Bundoora Park Conservation Area. A pair was flushed from Brown-back Wallaby-grass seasonal wetland (25.3) at a drainage line soak in the centre of the Conservation Area on 30 September 1991. Two other snipe were flushed nearby from dense Common Tussock-grass under River Red Gum (volcanic plain) grassy woodland (14.1). If disturbance from humans and dogs could be reduced, more birds would utilise the area, particularly when the grassland is inundated as birds arrive from the northern hemisphere in September. The Latham's Snipe population is likely to be an extension of that in the Strathallan Creek floodplain (see Gresswell Forest site), which is regarded as one of the most important remaining near Melbourne.

Ee 22^a: White-winged Triller and other foliage birds of the River Red Gums. Small populations of locally uncommon foliage birds were recorded in River Red Gum (volcanic plain) grassy woodland (14.1) at the Conservation Area on 28 February 1991. These included the Fan-tailed Cuckoo, Horsefield's Bronze-Cuckoo, White-winged Triller, Golden Whistler, Rufous Whistler, Grey Shrike-thrush and Olive-backed Oriole. Each were

likely to have bred in the Conservation Area. The mature and regenerating River Red Gums, tall wattles and grassland each play a role in supporting habitat for these birds, none of which were recorded in the parkland River Red Gum (alluvial plain) grassy woodland (14.3) fronting Plenty Road. The lack of understorey has enabled Noisy Miners to colonise and drive away these species. The Spotted Pardalote was not recorded, indicating it is possibly only a winter non-breeding visitor. Breeding sites for the pardalote along the creek and drainage lines have been eliminated. Mounds of sandy-loam soil may encourage nesting.

Planting additional River Red Gums and tall shrubs including Drooping Sheoke, Lightwood, Black Wattle, Golden Wattle and Tree Bursaria would benefit each of these species. Improved habitat links will be required to attract greater numbers of foliage birds. Enhancement work of habitat links and shrub planting may halt the dieback caused by insects and improve the health of the River Red Gums (see Conservation Measures).

Ef **22^a: Spiny-cheeked Honeyeater.** One was observed in remnant Lightwood–Tree Violet cliff/escarpment shrubland (20.5) along Darebin Creek on 8 March 1991. The species is a non-breeding autumn–winter visitor from coastal areas, attracted by the fruiting African Box-thorn (see site 20).

Mammals

22^a: Bats. Four common species were trapped in River Red Gum grassy woodland (14.3) on 28 February 1991 and the White-striped Freetail Bat was heard while spotlighting on 7 March 1991. On the basis of abundance of tree hollows, at least three other species might be present including the threatened Eastern Broad-nosed Bat and regionally threatened Eastern Freetail Bat (see Gresswell Forest site). Both bat traps were disabled (one was destroyed) by vandals on the first night of bat trapping. Unfortunately this was the most optimal night of the trapping effort and subsequent inclement weather prevented representative captures.

Reptiles

Cj **22^a: Bundoora Park.** Seven species including the Tussock Skink, White's Skink, Delicate Skink and Eastern Brown Snake were recorded in a 3-hour search of Bundoora Park on 28 February 1991. Areas covered included the Darebin Creek and the Conservation Area. All four of the above were only recorded in River Red Gum (volcanic plain) grassy woodland (14.1) at the Conservation Area. With the addition of several species observed during surveys by Grant Turner, a diverse assemblage of 13 species has been recorded at Bundoora Park. This is due to the area containing an overlap of alluvial and volcanic plain species.

Many of the species present occur as small populations and several were recorded only as single animals (e.g. Southern Water Skink, Eastern Brown Snake and Lowland Copperhead). Populations of these are severely depleted by habitat loss and fragmentation and considered unlikely to persist far into the future unless specific conservation management is undertaken (see Conservation Measures).

The Tussock Skink, which is a volcanic plains species, extends onto bordering sections of the alluvial plains of Bundoora Park, La Trobe University and Gresswell Forest. The species co-occurs with the Delicate Skink (foothill species) in only a few areas in GM. The Common Long-necked Tortoise was observed in the golf course dam (Grant Turner pers. comm.).

Ed **22^a: Eastern Small-eyed Snake.** One was taken in Lightwood–Tree Violet cliff escarpment (20.5) from the summit of Mt Cooper in 1986 during excavation of the scenic drive (Grant Turner pers. comm.). Most of the basalt floaters were removed and a population of the snake is considered unlikely to persist in the site.

Frogs

Ef 22^a: **Common Spadefoot Toad.** Several were calling in the Conservation Area (from both 14.1 and 25.3) after heavy rain on the evening of 7 March 1991. A chorus of about 20 Growling Grass Frogs was heard in the golf course lake on 30 September 1991. Both frog species have become scarce along inner sections of the creek. These may well be the most substantial populations remaining.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. The last external habitat link exists east to the La Trobe University Campus site. Ground fauna species are unable to cross Plenty Road but the link is operative for birds and bats.</p>	
<p>Loss and fragmentation of native grassland areas under grassy woodland. The grassland ecosystem in bordering areas of the site has been eliminated by urban development and much of that occurring within the site has been degraded by past land-use. The viability of many species and the overall grassland and grassy woodland ecosystem is declining.</p> <p>Severance of external habitat links. This may cause the elimination of several ground fauna species including the White's Skink, Lowland Copperhead, Eastern Brown Snake and Common Spadefoot Toad. The Conservation Area, which is the most important section for herpetofauna, has been stripped of ground fauna habitat such as rocks and logs.</p> <p>Defoliation and dieback of River Red Gums. Dieback of River Red Gums caused by excessive populations of foliage insects and deficient numbers of foliage birds was observed throughout Bundoora Park. This has been caused by habitat link fragmentation. Severe dieback on cycles of increasing frequency has occurred over the last decade in the large River Red Gums along Plenty Road. A psyllid and skeletoniser outbreak in November 1992 killed several trees. If this condition remains unaddressed, the viability of the entire stand will continue to decline.</p>	<p>Extensive weed control and replanting of indigenous vegetation along the creek is required both internal and external to the site (see BMG Quarry-Howy's site regarding the 'green web' link). The eastern link to La Trobe University and the psychiatric hospitals is critical for birds and bats. Tree planting at Larundel would benefit Bundoora Park. Any further loss or fragmentation of stands of River Red Gum in the area (e.g. Strathallan development) will result in the depletion of species at Bundoora Park. Maintaining the River Red Gum link between Larundel Hospital and Bundoora Park (the latter being the peripheral site on a habitat link) is of key importance in the Regional Habitat Link Strategy. Protection and enhancement of this link should be a primary management priority.</p> <p>Strengthen habitat links. Maintaining and enhancing the habitat link between Bundoora Park and La Trobe University will be critical for the continued viability of many of the grassy woodland fauna species at Bundoora Park. Regeneration of stands of River Red Gum grassy woodland will be necessary. The establishment of effective external habitat links along the creek is considered critical to the continued viability of ground fauna populations. Riparian links both upstream and downstream need to be protected and enhanced in accordance with the Regional Habitat Link Strategy. There are significant species and habitats present in the site and the establishment of fuller links will promote their long-term viability, which is currently threatened.</p>
Regional Hydrological Strategy	

Reduction of water quality and natural flow of the creek and elimination of instream and riparian habitat and fauna. See BMG Quarry–Howy’s site.

Establishment of water quality controls and guidelines for Darebin Creek. See BMG Quarry–Howy’s site.

Revegetation and conservation management of Darebin Creek. Further creek ‘improvements’ such as straightening and removing rock barriers to facilitate stormwater flow will be to the detriment of riparian fauna such as the Cunningham’s Skink and Southern Water Skink, which are already locally threatened. Weed removal, particularly of Gorse, Montpellier Broom and Spanish Artichoke, and follow-up native plantings will be necessary.

Other Issues

Weed invasion of the creek escarpments. The escarpments contain Gorse, Spanish Artichoke, Fennel, Serrated Tussock and Spear Thistle. Areas of Montpellier Broom occupy the stony crests and Toowoomba Canary-grass and Chilean Needle-grass dominate the low-lying areas. The Broom has been encouraged by creek 'improvement' earthworks and the high frequency of fires in the area. See BMG Quarry–Howy's site.

Access and disturbance to the Conservation Area. The Latham's Snipe are being disturbed by humans and unleashed dogs. Fallen hollow limbs and potential herpetofauna habitat are being removed. Some rubbish dumping occurs. Cats from nearby residential areas are night predators of birds.

Designation of the Conservation Area as a flora reserve. This is the area of highest botanical and zoological significance in the site. It provides an important grassland scientific reference area and should be designated as a flora reserve. The significance of the grassland vegetation and Latham's Snipe habitat suggests that the area should be protected from public access. A comprehensive plant survey and conservation management plan is required. The area requires fencing to keep people and dogs out and a perimeter shrub screen (e.g. Blackwoods) to provide more security for the snipe. Specific grassland management should be undertaken. This includes continued prescribed burning (as in March 1991), the replacement of ground debris such as rocks and logs for ground fauna (i.e. frogs and lizards), weed control (e.g. of Paspalum and Toowoomba Canary-grass) and native enrichment plantings. Controlled visitor access points and a nature trail could be established, accompanied by an interpretative brochure and nature trail guide.

Development of the wildlife reserve wetland. Trees and shrubs have been planted in the vicinity of the wetland. Providing greater structural and floristic diversity amongst the aquatic vegetation would attract greater numbers of waterbirds. A suggested improvement would include establishing submerged herbfield (e.g. Blunt Pondweed and Lake Eel-grass) for waterfowl, large waders and tadpoles which form important prey.

Establishing tall emergent herbfield (e.g. River Club-sedge and Tall Spike-sedge) would attract marshland passerine birds, rare cover-dependent species such as the Spotless Crake, and insects such as damselflies, which are important prey. The establishment of low emergent herbfield (e.g. Common Spike-sedge, Water Plantain and Swamp Crassula) would assist cover-dependent waders such as the Latham's Snipe and insects and micro-crustacea which are important prey. Placing logs and branches on the shoreline would provide additional habitat for invertebrates, reptiles and frogs.

Site 23 Dougharty Road to Plenty Road

- Map Reference:** 7922 268216 to 7922 267232 (Darebin Creek). 7922 275226 (La Trobe University retarding basin lake). One minute lat/long grids include 37° 43' x 145° 02'.
- Location/Size:** The Darebin Creek from downstream of Dougharty Road to Plenty Road. Approximately 130 ha.
- Municipality:** City of Darebin and City of Banyule (small section on east side of creek in south).
- Land Tenure/Use:** Public: Darebin Creek streamway (Melbourne Water) and parks and playing fields (City of Darebin) and La Trobe University. Private: adjoining residential and light industrial land.
- Landforms:** Volcanic plain (see PLVP C). Elevation is 55–70 m.

HABITAT SIGNIFICANCE:

Assessment: Medium—Category 2

Partially intact or small stands: Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); River Red Gum (drainage line) grassy woodland (14.4; Darebin Creek upstream of Summerhill Road footbridge); Woolly Tea-tree riparian scrub (18.2; Darebin Creek downstream of footbridge); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Kangaroo Grass stony knoll grassland (22.1); Blunt Pondweed (submerged herbfield) permanent wetland (26.1)

Endangered, vulnerable or rare species: nil.

FAUNAL SIGNIFICANCE: Site 23 Dougharty Road to Plenty Road

Assessment: Regional—Category 3 (D, E)

Reference grids for the significance keys include:

23^a: 37° 43' x 145° 02'; La Trobe University lower moat lakes/Darebin Creek

c. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 23^a: 17 species including the Yellow-billed Spoonbill, Darter and Little Egret at the retarding basin lake on 4 March 1991

i. Frogs

Local. 23^a: 4 species including the Growling Grass Frog and Striped Marsh Frog at the retarding basin lake on 4 March 1991

j. Reptiles

Local. 23^a: 5 species including the Cunningham's Skink, Common Blue-tongued Lizard and Tussock Skink near Darebin Creek footbridge on 28 February 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 23^a: 68 species

c. Native mammals

Local. 23^a: 2 species

d. Herpetofauna

Regional. 23^a: 15 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 23^a: 5 species

c. Regionally vulnerable fauna (R2 species)

Regional. 23^a: 2 species. **Birds:** Little Egret, Whiskered Tern

d. Regionally rare fauna (R3 species)

Regional. 23^a: 2 species. **Birds:** Darter. **Reptiles:** Marbled Gecko

e. Regionally depleted fauna (R4 species)

Local. 23^a: 1 species. **Birds:** Peregrine Falcon

f. Regionally restricted fauna (R5 species)

Regional. 23^a: 13 species. **Birds:** Australian Pelican, Great Egret, Cattle Egret, Australian Shelduck, Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet. **Reptiles:** Common Long-necked Tortoise, Cunningham's Skink, Tussock Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

Outlook

Habitat protection and enhancement works would be required to retain this site as regionally significant. The developing aquatic vegetation at the retarding basin wetlands has attracted greater numbers of waterbirds in recent years. This would increase if sections of the wetland were made sanctuaries from humans and screening vegetation was developed.

FAUNA

Other Significant Fauna

Birds

Ec **23^a: Little Egret and Whiskered Tern at La Trobe University retarding basin lake.** The egret was foraging in the mudflat shallows of the north-western shoreline on 28 February 1991. This species is a rare autumn–winter visitor to GM, predominantly recorded on artificial waterbodies. Only two other sightings were made in the urban area of NEM (sites 32 and 33). The Whiskered Tern has been observed over the lake (Ed Thexton pers. comm.). It was only recorded elsewhere in the urban area of NEM at site 32.

Ed **23^a: Darter and waterfowl roost at La Trobe University retarding basin lake.** A Darter and a Great Cormorant were roosting in a dead tree at a lagoon on the east side of the lake on 4 March 1991. This tree forms an overnight roost for about 30 waterbirds. Waterfowl roost on the north-west shoreline and islands in the moat system upstream of Kingsbury Drive. The Australian Wood Duck, Chestnut Teal and Pacific Black Duck breed in hollows amongst remnant River Red Gum grassy woodland (14.1) near the north end of the lake. The Australian Pelican and Australian Shelduck (both *Ef*) occasionally visit the lake (Ed Thexton pers. comm.).

Ee/Ef **23^a: Peregrine Falcon, Australian Hobby and other birds of prey.** A Peregrine Falcon (*Ee*) was recorded passing through the area in 1990 (Ed Thexton pers. comm.). Birds have bred in recent years nearby at the Heidelberg Repatriation Hospital. The hobby (*Ef*) has been observed on several occasions. A pair breeds in the Mont Park–La Trobe University Campus Wildlife Reserve area. Two were seen hunting together near the lake on 28 February 1991. Their main prey are Common Starlings, Common Mynas and Feral Pigeons which are abundant near the university buildings and along the moat system. A Brown Falcon was seen hunting for Field Mice over the wasteland between the lake and the Melbourne Water depot. It probably also breeds locally. The Brown Goshawk and Black-shouldered Kite have bred in recent years in stick-nests in River Red Gums (14.1) near the La Trobe retarding basin lake.

Ef **23^a: Great Egret and other waterbirds at La Trobe University retarding basin lake.** The egret was present in the shallows on both visits made to the lake (28 February 1991 and 4 March 1991). The lake contains a muddy shoreline, mudbars and shallows on the north-west side, large trees at the north end, relatively deep water in the south end and populations of (introduced) fish, particularly Goldfish, Mosquito Fish and Roach. Common Reed–Cumbungi emergent herbfield (25.7) occurs in the north section. Blunt Pondweed submerged herbfield (26.1) is establishing. A diverse population of frogs inhabits the grassy lagoon on the eastern side.

The lake and associated wetlands contain a moderate diversity of common waterbirds and small numbers of rarer species. Seventeen species of waterbirds were present on 4 March 1991 and 16 species including 80 Australian Wood Duck were present on 28 February 1991. A Yellow-billed Spoonbill and a pair of Black-fronted Plovers were feeding on the mudflats on 4 March 1991. The Purple Swamphen and Dusky Moorhen breed amongst Cumbungi (25.7) near Kingsbury Drive.

Ef **23^a: Rainbow and Little Lorikeet.** The Little Lorikeet and Musk Lorikeet were observed in River Red Gum grassy woodland (14.1) between the north end of the retarding basin lake and Kingsbury Drive on 4 March 1991. They both breed in the old River Red Gums near Chisholm College at La Trobe University. The Rainbow Lorikeet visits flowering plantation and street trees, particularly Yellow Gums and Red Ironbarks, in urban Heidelberg. These birds breed along the Yarra River and the lower Plenty River and Diamond Creek.

Reptiles

Ed **23^a: Marbled Gecko.** One was located south of the footbridge, amongst a rock batter on the eastern side of the creek. The gecko is also found in nearby industrial areas amongst stacks of timber.

Ef **23^a: Cunningham's Skink, Tussock Skink and other reptiles.** Eight reptile species were recorded, which is relatively diverse for the urban area. Several are present in low numbers and were recorded only as single animals. The Cunningham's Skink persists in remnant Lightwood–Tree Violet cliff/escarpment shrubland (20.5) in cliffs on the east side of the creek opposite the end of Northern Road. The Tussock Skink was located upstream in a small area of Kangaroo Grass stony knoll grassland (22.1) near the Banyule side of the footbridge. One was also located under a pile of branches amongst regenerating River Red Gums and Kangaroo Grass (14.1) by the entry loop to La Trobe University off Kingsbury Drive.

An Eastern Brown Snake was located amongst rubble between the retarding basin lake and the Melbourne Water depot. They are occasionally seen by the nearby La Trobe University moat system. These snakes have been depleted by human disturbance and habitat loss and fragmentation and are considered unlikely to survive. The Tiger Snake may continue to persist in low numbers. The Weasel Skink, which was not recorded in the site, was located in a paling fence near Northern Road. This species has established in the older northern suburbs. The Common Long-necked Tortoise also occurs in the retarding basin lake. It is known to have been released in the university moat system.

Frogs

Ef **23^a: Striped Marsh Frog and Common Spadefoot Toad.** Seven frog species were recorded in the site. The Growling Grass Frog and Striped Marsh Frog occur in the retarding basin lake and the Common Spadefoot Toad occurs in the meadows between the lake and the Melbourne Water depot.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. The only external habitat link is north to La Trobe University. The link is operative for birds and bats. Maintenance and enhancement of habitat links along Strathallan Creek to the La Trobe University Campus Wildlife Reserve and through the River Red Gums to Chisholm College will be critical for continued viability of grassy woodland fauna species. Revegetation work toward Bell Street is re-establishing a downstream link.</p>	
<p>Habitat loss, habitat link severance and recently eliminated herpetofauna species. The site is degraded, weed invaded and linear in shape, sharing a long boundary with urban and industrial areas. The viability of most ground fauna populations is declining. Areas have been stripped of ground fauna habitat such as rocks and logs. The Southern Water Skink and Red-bellied Black Snake, which were present in the early 1970s, were eliminated by habitat removal when the creek was straightened.</p> <p>The Little Whip Snake has been eliminated by habitat loss, rock disturbance and the high frequency of grassfires in the area which exposed them to predation from nocturnal hunters (e.g. foxes and cats). These species and the Tussock Skink have been eliminated from the section of the creek between Darebin Parklands and Dougharty Road. Cunningham's Skink persists in this section only in the cliffs between Livingstone Street and Banksia Street. The Large Striped Skink, which occurs on stony crests upstream at the BMG Quarry–Howy's site, was not recorded in the Dougharty Road to Plenty Road site.</p> <p>Dieback of the River Red Gum woodlands and lack of foliage birds. See Bundoora Park site.</p>	<p>Improve habitat links. See Darebin Parklands, Bundoora Park and BMG Quarry–Howy's sites.</p> <p>Require improved conservation and land management. See both the Bundoora Park and BMG Quarry–Howy's sites.</p>

Regional Hydrological Strategy

<p>Reduction of water quality and natural flow of the creek and elimination of instream and riparian habitat and fauna. See BMG Quarry–Howy's site and Darebin Parklands site.</p>	<p>Revegetation and conservation management of Darebin Creek. Further creek 'improvements' such as straightening and removing rock barriers to facilitate stormwater flow will be to the detriment of riparian fauna such as the Cunningham's Skink, which are already locally threatened. Weed removal, particularly of Gorse, Montpellier Broom and Spanish Artichoke, and follow-up native plantings will be necessary. See Darebin Parklands site.</p> <p>Further development of the lower moat system wetlands for waterbirds. See both the Bundoora Park and BMG Quarry–Howy's sites.</p>
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Establishment of water quality controls and guidelines for Darebin Creek. See BMG Quarry–Howy’s site.

Other Issues

Fires, weed invasion and vandalism. On average, the site is burnt every two to three years. This is a problem all grassland areas encounter in the northern suburbs. The fires have spread the Gorse, thistles, Fennel and Montpellier Broom and have killed regenerating River Red Gums. Vandals partly destroyed an establishing plantation of Black Wattles and River Red Gums near the corner of Crissane Road and Sheehan Road in February 1991. Most fences on this side have been damaged.

Site 24 Darebin Parklands

Map Reference:	7922 269167 to 7922 266177 (Darebin Creek). One minute lat/long grids include 37° 46' x 145° 01' to 145° 02'.
Location/Size:	The Darebin Creek and adjacent open space from Upper Heidelberg Road Darebin to Abercorn Avenue Ivanhoe. Approximately 40 ha.
Municipality:	Cities of Banyule and Darebin.
Land Tenure/Use:	Public: Darebin Parklands (Cities of Banyule and Darebin). Private: rear of residential properties backing Rockbeare Grove and Wynstay Crescent.
Landforms:	Volcanic plain and alluvial plain (see PLVP C). Elevation is 20–40 m.

Natural Heritage Values

Landscape. The creek valley and gorge provides a meeting point of basalt and sandstone. It is the most rugged and diverse terrain of the Darebin Creek system. The wetlands in the infilled Separation Street tip and on the terrace below Pine Ridge add further diversity. The valley contains significant historical features such as an old weir and the old coach and bullock dray track. On the Northcote side, the track contains an avenue of White Mulberry trees planted by the early settlers.

Scientific and Educational Values

Rehabilitation and management. Darebin Parklands is a monument to community and local government cooperative involvement and provides one of the most lasting and important models for such works in GM.

Public interpretation. Darebin Parklands has a high public profile and usage. The parkland provides vital open space as well as an outdoor education centre on natural heritage. It exposes conservation issues and programs to multicultural sections of the community. Experiencing the works and achievements has transformed the area from a source of disdain and ignorance to one of pride and understanding amongst the local community.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Golden Wattle cliff/escarpment shrubland (20.4; eastern escarpment); Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7; wetland below Pine Ridge and Separation Street quarry wetland)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1; west of creek/Yarana Road); River Red Gum (alluvial plain) grassy woodland (14.3; east of creek/Rockbeare Grove); River Red Gum (drainage line) grassy woodland (14.4; Donaldsons Creek); River Red Gum (terrace) floodplain riparian woodland (16.5; Darebin Creek downstream of Donaldsons Creek); River Red Gum (creek) floodplain riparian woodland (16.6; Darebin Creek downstream of Donaldsons Creek); Woolly Tea-tree riparian scrub (18.2; Darebin Creek upstream of Donaldsons Creek); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; west escarpment of Darebin Creek); Blunt Pondweed (submerged herbfield) permanent wetland (26.1)

Endangered, vulnerable or rare species: nil

Notable features: Drooping Sheokes on eastern cliffs of Darebin Creek below Wynstay Crescent, Golden Wattle shrubland on Pine Ridge below Rockbeare Grove and River Red Gum grassy woodland below south end of Rockbeare Grove; tessellated pavement/remnant riparian scrub below Yarana Road; revegetation areas, notably Yarana Road cliffs, Pine Ridge, Darebin Creek banks, terrace wetland below Pine Ridge and Separation Street quarry escarpment.

FAUNAL SIGNIFICANCE: Site 24 Darebin Parklands

Assessment: Regional—Category 2 (C, D, E)

Reference grids for the significance keys include:

24^a: 37° 46' x 145° 01'; Darebin Parklands

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 24^a: 10 species on 29 December 1986 and 7 species on 7 January 1991

d. Breeding waterfowl

Local. 24^a: Australasian Grebe at the quarry wetland and Pacific Black Duck along the creek on 7 January 1991

k. Frogs

Local. 24^a: 5 species including the Growling Grass Frog on 29 December 1986

l. Reptiles

Regional. 24^a: 7 species including the Red-bellied Black Snake and Southern Water Skink (both along the creek below Wynstay Crescent) and the Cunningham's Skink (basalt cliffs upstream of the railway bridge) on 29 December 1986

m. Freshwater fish

Unranked. 24^a: no native species electrofished from lower Donaldsons Creek or from Darebin Creek at Abercorm Avenue in 1991 (Raadik in prep)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 24^a: 116 species

b. Native birds

Regional. 24^a: 92 species

c. Native mammals

Local. 24^a: 5 species (no mammal trapping was conducted; expect several additional bats)

d. Herpetofauna

Regional. 24^a: 19 species in 1986 (now possibly 8 reptile species fewer)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 24^a: 5 species

d. Regionally rare fauna (R3 species)

Regional. 24^a: 1 species. **Reptiles:** Marbled Gecko

e. Regionally depleted fauna (R4 species)

Regional. 24^a: 4 species. **Birds:** Peregrine Falcon, White-winged Triller. **Reptiles:** White's Skink, Red-bellied Black Snake

f. Regionally restricted fauna (R5 species)

Regional. 24^a: 13 species. **Birds:** Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Spiny-cheeked Honeyeater. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Cunningham's Skink, Tussock Skink

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

Local. 24^a: small flocks of Cattle Egrets in recent years

Outlook

Since 1978, the faunal significance of the site has advanced for avifauna due to revegetation works and declined for reptiles due to habitat fragmentation, disturbance from humans and predation from cats and dogs.

FAUNA

Rare or Threatened Fauna

Bd **24^a: Eastern Quoll.** There were reports of Eastern Quolls raiding fowl sheds along the lower Darebin up to the late 1930s. In the 1920s they were still regarded as locally common. On 26 October 1925 one was captured in a chaff bin in a coachhouse at Ivanhoe. There is a specimen taken in a rabbit trap from Darebin in August 1931 (Donald Thomson collection at the Museum of Victoria; Dixon and Huxley 1989).

Other Significant Fauna

Birds

Ee/Ef **24^a: Peregrine Falcon and Australian Hobby.** Both are frequently seen hunting starlings and Feral Pigeons along the Darebin Creek valley. They nest locally on tall buildings (e.g. Heidelberg Repat and Austin Hospital).

Ee **24^a: White-winged Triller.** One was present on the northern slopes of Pine Ridge on 7 January 1991. The triller is a spring–summer migrant from inland Australia which is rare in the urban area.

Ef **24^a: Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron and other waterbirds.** Most of these species are visitors from the Yarra, particularly the nearby billabongs of Kew and Ivanhoe (site 31). Two artificial wetlands have been created at Darebin Parklands: the Separation Street quarry wetland (early 1980s) and the terrace wetland on the east side of the creek (mid-1990s after several earlier attempts). The Separation Street tip, Darebin Creek and floodplain terraces supported 10–15 species of waterbirds in the 1970s. These largely consisted of common urban species including the Masked Lapwing, White-faced Heron and Pacific Black Duck. Several rarer species including the Royal Spoonbill, Yellow-billed Spoonbill, Great Egret and White-necked Heron have always been winter visitors. These have mostly been seen roosting in old dead River Red Gums, several of which have now fallen. The tip attracted the Silver Gull, Black-fronted Dotterel and Australian White Ibis. Since its filling, these have become rarer.

With the establishment of the artificial wetlands and maturing of riparian plantations a few new visitors have been recorded. The Nankeen Night Heron has been seen on several occasions in the River Red Gum/Manna Gum plantation upstream of the footbridge during the 1990s. The herons have been mostly juveniles, likely originating from breeding/roosting colonies along the Yarra River. The artificial wetlands have attracted open water and reed-bed species, including the Australasian Grebe, Eurasian Coot, Purple Swamphen, Dusky Moorhen and Chestnut Teal, and marshland passerines, including the Clamorous Reed-Warbler and Little Grassbird. In recent year small flocks of Cattle Egrets have appeared during winter in the parklands and playing fields.

Ef **24^a: Purple-crowned Lorikeet and Spiny-cheeked Honeyeater; autumn—winter visiting woodland birds.** Two Purple-crowned Lorikeets and several Musk Lorikeets were feeding in flowering Yellow Gums near the Yarana Road–Smith Street corner of the park. A Spiny-cheeked Honeyeater was feeding on mulberries at Mulberry Spur in March 1990. This species moves into the suburbs of Melbourne during autumn–winter, probably originating from the scrubs of Port Phillip Bay.

24^a: autumn–winter visiting forest birds. A Yellow-faced Honeyeater and a small flock of White-naped Honeyeaters were feeding in the flowering Swamp Gums in the plantation upstream of the footbridge in June 1990. Several Gang-gang Cockatoos were feeding on ripened Hawthorn berries near the cascades upstream of Pine Ridge in March 1990. A flock of Pied Currawongs was also present in the park. These and the gang-gangs move down the Yarra Valley from the hills at this time of year. Another significant return has been the Spotted Pardalote, which was recorded for the first time in June 1990, in the plantation upstream of the footbridge. It will be important for the health of River Red Gums in the future that the pardalote can be encouraged to stay and breed. None of the above species were recorded in the 1970s.

24^a: spring–summer visiting forest birds. A Sacred Kingfisher was seen in the large River Red Gums below Pine Ridge on 7 January 1991. It was later seen hawking Christmas Beetles amongst the River Red Gum and Manna Gum plantation, upstream of the footbridge on the Northcote side of the creek. It returned to one of the large River Red Gums on several occasions with beetles where beckoning young were heard from one of the

tree hollows. This is one of the more significant forest species to have returned to this section of the parkland. They occasionally visited in the 1970s and bred in the River Red Gums along the lower reaches of the Donaldsons Creek. A small flock of Varied Sittellas was present working loose bark on the upper limbs of the Manna Gums.

An Olive-backed Oriole was seen in the same area in October 1990. A Rufous Whistler was present in the Manna Gum and Yellow Box plantation of the amphitheatre to the south of Pine Ridge on 7 January 1991. The whistler is very rare in the district (see site 31). The oriole breeds along nearby sections of the Yarra River, demonstrating the importance of the downstream link along the Darebin. The establishment of dense shrublands has successfully attracted the Grey Shrike-thrush and some winter visitors including the Golden Whistler.

24^a: newly resident birds. As the plantations matured, species which were absent in the 1970s began visiting in the late 1980s. Some of these, including the Grey Shrike-thrush and Grey Currawong, are now resident. Both species were accompanied by young in the Manna Gum and Yellow Box plantation of the amphitheatre to the south of Pine Ridge on 7 January 1991. Other species that were rare, have become more common. These include the Rainbow Lorikeet, Superb Fairy-wren, Brown Thornbill and White-browed Scrubwren.

Reptiles

Ed **24^a: Marbled Gecko.** Observed in the basalt cliffs (Lightwood–Tree Violet cliff/escarpment shrubland; 20.5) below Smith Street and Yarana Road in March 1990. Also recorded in a house garden at Alphington (Ian Mansergh pers. comm.).

Ee **24^a: White's Skink and Red-bellied Black Snake—both presumed locally extinct since 1986.** The White's Skink persisted in precariously low numbers amongst a remnant stand of River Red Gum (volcanic plain) grassy woodland (14.1) on the railway reserve between Fairfield and Alphington in 1986. One had been observed at Darebin Parklands on the grassy escarpment south-west of Pine Ridge in April 1979. The skink is now locally extinct. The last Red-bellied Black Snake seen was in River Red Gum floodplain riparian woodland (14.6) at the cascades below Wynstay Crescent on 29 December 1986. This species, which was already very rare, is presumed locally extinct.

Ef **24^a: Cunningham's Skink and Tussock Skink.** Seventeen species of reptiles were recorded at Darebin Parklands in 1979. This was one of the most diverse reptile assemblages known in Greater Melbourne. Possibly eight of these have become locally extinct, the regionally restricted (*Ef*) Large Striped Skink, Bougainville's Skink and Little Whip Snake apparently between 1979 and 1986. The Lowland Copperhead also became locally extinct in this period. The Common Blue-tongued Lizard and Eastern Brown Snake have not been recorded in surveys since 1986. The brown snake was relatively common in the basalt escarpment of the old tip in 1979. The Southern Water Skink, Cunningham's Skink, Tussock Skink and Eastern Three-lined Skink have declined to seemingly low populations with records of only single animals in the 1990s.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. There is a partially intact habitat link downstream along Darebin Creek to the Bailey Billabong site and severed links upstream to the Dougharty Road to Plenty Road site and La Trobe University site.</p>	
<p>Habitat degradation and fragmentation—reptile extinctions. Despite concerted conservation management by local councils and authorities, the biological values of the lower and middle Darebin Creek are diminishing. Many species have become extinct. Others and their habitats are on the brink. Several reptile species that probably occurred in the site such as the Tree Dragon and Southern Lined Earless Dragon (last recorded nearby at Yarra Bend in the 1880s) have been locally extinct for the greater part of the twentieth century.</p> <p>The local extinction of several reptiles in recent years (see Fauna) has resulted from loss of habitat links, predation from dogs and cats, increased disturbance from humans and loss of rocks and rank grassland habitat through grooming and mowing. Snakes are killed as soon as they enter backyards or cross roads. The main conclusion to be drawn is that reptiles are better indicators of habitat loss and fragmentation or ecosystem fitness than birds (see Conservation Measures). Birds are able to recolonise in a direct ratio to the level of habitat restoration that has been achieved. The elimination of reptile species in situations such as Darebin Parklands is usually an irreversible event as recruitment via habitat links from elsewhere has been eliminated. This is why so much importance is placed on extensive volcanic plains grassland areas such as the Craigieburn Grassland, which still contain intact reptile assemblages.</p>	<p>Restoration of habitat links along Darebin Creek. This should be a focus for conservation planning and management in the site. Over the last two decades, sections of the creek and catchments (e.g. Darebin Parklands, Bell Street, La Trobe University Campus Wildlife Reserve, Gresswell Forest and Bundoora Park) have been extensively restored and revegetated. This has attracted many native bird species back to the lower Darebin system. Riparian links both upstream and downstream need to be enhanced. Improvement of urban streamway links through revegetation programs is a high priority of the Regional Habitat Link Strategy in NEM (see Volume 1). There are significant species and habitats present in the site and the establishment of more effective links will promote their long-term viability, which is currently threatened.</p> <p>Avifauna research toward a habitat link restoration plan on the lower Darebin. Permanent scientific reference sites such as repeatable bird census transects would determine the advance of the bird recovery along the creek. Data is needed to determine the optimal structure and floristic composition for breeding populations of foliage insectivores such as the Sacred Kingfisher, Spotted Pardalote, Golden Whistler and Rufous Whistler. These species are essential to curb the dieback of important local stands of River Red Gums (e.g. La Trobe University) and the death of individual trees throughout suburban Heidelberg and Ivanhoe.</p>

Habitat degradation and fragmentation—mammal extinctions. The story for the mammals is worse. Locally extinct by the twentieth century were the Eastern Quoll (see *Bd*) and probably the Koala, Brown Antechinus, Brush-tailed Phascogale, Common Wombat, Black Wallaby and Eastern Grey Kangaroo. The Echidna, Fat-tailed Dunnart, Swamp Rat, Platypus (last seen in 1947; Anthea Fleming pers. comm.) and Sugar Glider became locally extinct around the middle of this century.

Data on breeding populations of insectivorous birds would quantify the effectiveness of habitat links as faunal corridors. Eucalyptus dieback is related to the degree of habitat fragmentation and modification. Insectivorous birds and the rate of insect defoliation should be monitored to provide feedback on eucalyptus dieback. Establishing linear habitat strips needs to be avoided as these tend to be occupied by aggressive native species such as the Noisy Miner, which leads to tree dieback. The aim of research should be to produce a habitat link restoration plan for the lower Darebin.

Regional Hydrological Strategy

Elimination of native fish. The only likely exception would be the Short-finned Eel which is tolerant of low water quality conditions. No native species were electrofished from the lower Donaldsons Creek and from the Darebin at Abercorn Avenue in 1991 (Raadik in prep.). Common Galaxias were taken from the creek at Ivanhoe in December 1907 and Preston in April 1914. A weir has since been built about 300 m upstream of the Yarra. This blocks the movements of migratory species with the exception of the Short-finned Eel. The creek once formed likely breeding habitat for the galaxias and several other species which have been eliminated from the entire Darebin system (e.g. regionally vulnerable Flat-headed Gudgeon, potentially threatened Freshwater Blackfish and vulnerable Australian Grayling).

Creek alterations and poor water quality.

The aquatic ecosystem of the Darebin Creek is one of the most depleted of all major streams (including urban streams) in NEM. With the exception of the adaptable Water Rat and Common Long-necked Tortoise (which may originate from the Yarra), no instream vertebrate species of significance live there. The placement of the trunk sewer line and a broken weir upstream of the retarding basin has deviated the course of the creek. Spill from the old Separation Street quarry has altered the western escarpment. The water is polluted. The quarry was infilled as the City of Northcote tip in the early 1970s. Leachate from the tip enters the creek. Creek pollution from upstream sources has had a deleterious effect on instream fauna.

Streamway conservation. Fish and streamway fauna are under threat throughout NEM. As recommended in the Regional Hydrological Strategy (Volume 1), protection and revegetation is required for bushland within 100 m of the break of slope of escarpments of all major streams in NEM. To achieve this objective, councils need to consider implementing a planning overlay on private land to protect bushland within urban streamways. Streamway management of the Darebin Creek needs to aim at improving water quality to the level required for the re-establishment of native fish and recruitment of significant fauna such as the Platypus.

Implementing the overlay requires raising the level of community awareness and involvement. Without this, the problems of water pollution and declining riparian habitat quality of Darebin Creek cannot be properly addressed.

 Other Issues

Decline and steady weed invasion of grasslands. The lava plains on the Northcote side of the creek are dominated by Chilean Needle-grass, brome grasses and Yorkshire Fog. The basalt rocks have been heavily picked to allow mowing. These now contain few notable herpetofauna species. The cliffs contain Serrated Tussock and Spear Thistle. Areas of Panic Veldt-grass, Cocksfoot, Brown-top Bent, Toowoomba Canary-grass and Chilean Needle-grass occur on the floodplains and sedimentary escarpments of the Ivanhoe side. Native grassland areas have contracted.

The negative landscape elements. Sections of the Darebin valley upstream of Darebin Parklands consist of wasteland flanked by the rear fences of houses on the eastern side and small industries and commercial areas on the west. The creek and terrace and lower escarpment vegetation is choked with weeds and accumulated rubbish. The few aesthetic features such as River Red Gums are in decline.

Community education program. Success for streamway conservation will rest upon an education program which nurtures community (particularly adjoining landowner) awareness. This will need to clearly demonstrate the vital role of buffering habitat on private land in the restoration plan of the habitat link along the creek.

 The History and Future of Conservation Works for the Valley

Please note: Although restoration works have continued over the last 17 years, only the first year, when the foundations were being laid, is detailed in the following sections. A photographic (before and after) and planting inventory for all works is essential. The provenance of plants needs to be documented as does the planting location, habitat, density and survival rate.

Some late 1970s perspectives. One hundred and forty years of land settlement had taken great toll on the natural heritage values of the valley. The author first visited the area that was to become Darebin Parklands in December 1978. First impressions of the Northcote side from the corner of Waverley Avenue and Wynstay Crescent was of a horse paddock, gone wild with Blackberry, Spanish Artichoke and Hawthorn. The Separation Street tip had recently filled and broken cars, disgorged garbage and rotting animal carcasses spewed over the basalt escarpment at the end of Smith Street. Behind the backyard fences of Rockbeare Grove the sandstone escarpments were covered by a shroud of box-thorn and creeper. Along the creek a smell of sullage pervaded the air and billowing detergent foam floated on the pool below the cascades, choked downstream by plastic bottles and building rubble. For no apparent reason the creek would suddenly rise and just as suddenly fall. The water would change colour, occasionally green, sometimes blood red.

Rockbeare Park Conservation Group. In cooperation with the City of Heidelberg (Banyule), the group commenced conservation works in 1973. It was composed of aware and determined local residents who set out to restore the lower Darebin Creek valley. In the late 1970s, the City of Northcote (Darebin) purchased the adjoining Albion Reid tipsite and a wedge of land covering the sewer easement on the west side of the creek. This land had been previously acquired by the MMBW with the assistance of a State Government subsidy. The Rockbeare Group reformed under a committee of management shared by the Cities of Heidelberg and Northcote to cover both sides of the valley in 1979. Out of this rose the Darebin Parklands Association in 1980. The charter of the association was the dual purpose of preserving the history and restoring the naturalness of the valley.

A ranger at Darebin Parklands. A part-time ranger under the supervision of the Rockbeare Park Conservation Group, was appointed by the City of Heidelberg (Banyule) in autumn 1979. Some months later, the Cities of Heidelberg and Northcote (Darebin) jointly funded a part-time ranger. A full-time ranger has been employed since about 1982.

Weed eradication program—the task begins. In 1979, a team from the (then) Vermin and Noxious Weeds and Destruction Board of the Department of Crown Lands and Survey, conducted an intensive weed eradication program over about eight weeks. They began with woody plants on the Ivanhoe side. With chain saws they cleared African Box-thorn and Hawthorn from the escarpments, painting the stumps with the now condemned herbicide 2,4,5-T. As these and other woody weeds, including Montpellier Broom, Flax-leaf Broom and Myrtle-leaf Milkwort, were cleared, areas and plants lying inaccessible and unseen for decades were opened up. One such area was an amphitheatre at the northern foot of Pine Ridge which contained some fine old River Red Gums. English Ivy strangled the trunks up to about 7 or 8 metres. Several trees had been killed by the creeper.

On the Northcote side, box-thorn, Gorse, Fennel, and Spanish Artichoke were targeted. The artichoke was spot-sprayed with 2,4-D blended with a highly active agent called picloram (Tordon 50-D) which prolonged soil-life of the herbicide, necessary to kill the seedlings. Broad-scale use of these chemicals later became prohibited due to their reported carcinogenic and mutagenic properties. Without their use, such inroads into weed infestations along the Darebin would not have occurred.

Follow-up weed control—willows. There is now a range of safer, but less effective and somewhat expensive, weedicides such as Garlon. Ongoing use of these in combination with mechanical removal will need to be employed. The broom, along with willows, alien grasses and creepers, still constitutes a major threat to the parklands. The pros and cons of the willow debate continue. They do provide habitat for roosting waterbirds and nesting pardalotes and kingfishers. They do hold banks together, but they destabilise them by eliminating native species. Their roots choke the waterway and their dispersal mechanism makes them highly invasive. They provide inferior foraging habitat for insectivorous birds.

Without delving into local social issues of the willow debate, this study consistently advocates the need to control the spread of this environmental weed along the waterways of North East Melbourne (see site 50, Volume 1, etc.). Work needs to be undertaken with much care otherwise damage to stream banks can result. A systematic approach is necessary. No more than one in three trees should be drilled and poisoned each year. River Red Gums and riparian shrubs such as Silver Wattle and Swamp Paperbark need to be first established in the affected areas. Trees should be left standing, or at a minimum lopped (e.g. branches overhanging paths).

Early revegetation works—low budget and volunteer workforce. The original master plan for the development of Darebin Parklands contained oak lawns, birch avenues and the like. While aesthetically in keeping with the spacious gardens of Ivanhoe, it was inappropriate for the natural environment of the parklands. Urgent planting was required as several hectares of escarpments and creek banks had been cleared in the weed removal program. Immediate targets for planting were screening the housing backdrop of Yarana Road near Smith Street and protecting the park from prevailing north-westerly winds; consolidating the loose and dangerous rock on the tip escarpment and screening the City of Northcote depot; consolidating the creek bank on the Northcote side upstream of the footbridge; and revegetating the floodplain amphitheatres and adjacent terraces and spurs on the Ivanhoe side.

With indigenous plant nurseries still in the future, stock was obtained in 1979 from the State Schools Nursery at Chadstone and the Forest Commission Nursery at Mt Macedon. Where available, details were obtained from the propagators of where the seed had been collected. Every effort was made to obtain stock from the nearest known and suitable provenance in the Melbourne area. Three thousand five hundred trees and shrubs were planted, staked and mulched. Over half still thrive. Many of the previous plantings had failed because they had been scattered far and wide, becoming lost amongst the alien sward or falling to vandalism. This was overcome by block planting.

For the record, the numerically most abundant plants used (Manna Gum, River Red Gum, Yellow Box, Drooping Sheoke, Blackwood, Black Wattle and Golden Wattle), came from the Keilor Plains. The Blue Box planted on the tip escarpment came from near Bacchus Marsh. The Swamp Gums came from the Dandenong Creek valley. The Gold-dust Wattles planted on Pine Ridge came from Yarra Bend. The shelterbelt Yellow Gums planted on the tip escarpment and at the corner of Smith Street were a western Victorian provenance. These are now a haven for lorikeets.

The main blocks established in 1979 were as follows:

- River Red Gum, Manna Gum and Swamp Gum along the western bank and creek terrace upstream of the footbridge

- Yellow Box, Black Wattle and Golden Wattle on the northern escarpment of Pine Ridge
- Yellow Box, Candlebark and Manna Gum on the escarpment and broad amphitheatre to the south of Pine Ridge
- Blue Box, River Red Gum and Yellow Gum shelterbelt on the tip escarpment above the west side of the creek
- Yellow Gum, Red Box, Yellow Box and Blue Box shelterbelt near the corner of Smith Street and Yarana Road

Smaller blocks were also established. These included Drooping Sheoke and Blackwood along the basalt escarpment at Smith Street and Swamp Paperbark near the terrace wetland on the Ivanhoe side. Most of the creek plantings of Woolly Tea-tree, River Bottlebrush and Silver Wattle were swept away in the first floods. Recent plantings along the creek have been more successful.

Nurturing the cooperative spirit. The volunteer support during the planting epic involved all age groups from school children to pensioners. Difficult jobs became enjoyable as ideas and activities were shared. As the group learned new skills it became self-determining. Local seed was collected for the first time in 1979 and seedlings were 'fostered' out to members of the Rockbears Group for growing on over the summer. The individual attention given to these plants was a valuable contribution to the cooperative effort. A thousand were planted in 1980.

Future plantings. Extensive herb layer plantings are required, from Kangaroo Grass and grassland daisies on the stony plains, to Weeping Grass and Spiny-headed Mat-rush on the escarpments to Common Tussock-grass and sedges along the floodplain terraces. The method of germinating seed on strips of carpet underlay and placing these on sprayed alien swards should be used.

Recruitment of birds due to restoration and revegetation works. The native bird list in 1979 at the commencement of the works was 44 species. This was made up mostly of open space, farmland and urban species and very few bushland birds (3 species including the Laughing Kookaburra, Eastern Yellow Robin and Golden Whistler). In 1991 the list was over 80 species, 22 of which were bushland birds. New arrivals include the Brown Goshawk, Gang-gang Cockatoo, Crimson Rosella, Purple-crowned Lorikeet, Sacred Kingfisher, Horsefield's Bronze-Cuckoo, Tree Martin, Rufous Whistler, Grey Shrike-thrush, Crested Shrike-tit, White-winged Triller, Dusky Woodswallow, Varied Sittella, Spotted Pardalote, White-naped Honeyeater, Yellow-faced Honeyeater, Olive-backed Oriole, Grey Currawong and Pied Currawong.

Darebin Parklands can now offer an impressive birdlist. Birds such as the Spotted Pardalote and Grey Shrike-thrush have recently appeared in the establishing plantations upstream of Darebin Parklands. With further plantings a link will develop for these species between the Yarra River and La Trobe University.

Fauna and faunal habitat protection and recovery plan. Given the biological significance of sections of the lower Darebin Creek, past and present threatening processes on fauna and faunal habitat should be reviewed and assessed. A concept plan needs to be formulated that develops a set of management guidelines for long-term population recoveries of fauna species. This should consolidate existing works and integrate future work efforts and resources. The key issues to be addressed are the protection of all existing faunal species and habitats and the enhancement of natural habitat and habitat links. Emphasis should be placed on the potential impact of threats on fauna, and interpretation and education facilities and programs.

Vermin and domestic animals. Control programs that maximise floral and faunal values should be conducted. Fox culling and feral and domestic cat and dog controls are viewed as the major areas in need of attention.

VOLUME 3

ALLUVIAL PLAINS

Yarra Lowland Alluvial Plains (YLAP)

- YLAP A. La Trobe University–Mont Park
- Site 25. Gresswell Forest–Strathallan Link–Hospitals
- Site 26. La Trobe Campus Wildlife Reserves–Moat System
- YLAP B. Plenty River Lower Reaches
- Site 27. Plenty River Flats
- Site 28. Simpson Barracks
- YLAP C. Yarra Bend Park
- Site 29. Dights Falls
- Site 30. Yarra Bend Park
- YLAP D. Yarra River Chandler Highway to Plenty River
- Site 31. Bailey Billabong–Willsmere Lagoon–Hays
- Site 32. Banyule Flats–Warringal Swamplands
- Site 33. Bolin Billabong Bulleen
- YLAP E. Yarra River Plenty River to Diamond Creek
- Site 34. Bonds Road–Birraring Park–Westerfolds Park
- Site 35. Lower Eltham Park–Wingrove Park–Thomsons

Plenty Upland Alluvial Plains (PUAP)

- PUAP A. Glenvale
- Site 36. Mornmoot Lake–Plenty River West Branch
- Site 37. Towts Swamp
- PUAP B. Plenty River Yan Yean
- Site 38. Dunnetts Road Swamp–Plenty River Cades Road
- Site 39. Mernda to Yan Yean

HABITATS of the Alluvial Plains

5.1. Riparian Forest—riverbank

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 34^a, 35^b

Distribution: localised in YLAP E

Landforms: alluvial plain—riverbank (Yarra River in upstream section of Westerfolds Park)

Canopy: **Manna Gum**; 20–30 m tall and 20–30% cover

5.2. Riparian Forest—floodplain terrace

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 35^b

Distribution: localised in YLAP E

Landforms: alluvial plain—first (Yarra River) and second order (Plenty River) stream floodplain terraces

Canopy: **Manna Gum**; Yellow Box, Swamp Gum and Narrow-leaf Peppermint; 20–30 m tall and 20–30% cover

5.3. Riparian Forest—creek

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 35^{ab}

Distribution: restricted in YLAP E

Landforms: foothill and alluvial plain—creeks

Canopy: **Manna Gum**; with Yellow Box; 20–30 m tall and 20–30% cover

6.1. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally depleted

Reference or relatively intact and extensive stands or partially intact or small stands: nil

Distribution: restricted in the northern sections of PUAP A

Landforms: foothill—sheltered hill-slopes and valleys

Canopy: **Red Stringybark**; with Long-leaf Box, Yellow Box, Red Box and Narrow-leaf Peppermint; 15–20 m tall and 25–40% cover

7.1. Riverine Forest—floodplain

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 39^b

Distribution: restricted to PUAP B, where eliminated apart from a small stand at the south end of Watts Lane at Yan Yean (Brennans forest)

Landforms: alluvial floodplain

Canopy: River Red Gum; 20–30 m tall and 20–25% cover

10.1. Gully Woodland—creek

Conservation status: regionally threatened

Partially intact or small stands: 27^b

Distribution: restricted in YLAP B, ?PUAP A

Landforms: foothill—minor streams

Canopy: Manna Gum; with Yellow Box, Swamp Gum, Narrow-leaf Peppermint and Candlebark; 15–25 m tall and 10–25% cover

10.3. Gully Woodland—sheltered valley

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 28^b

Distribution: formerly widespread in PUAP A (where mostly eliminated); restricted in YLAP E

Landforms: alluvial plain—floodplains and sheltered gullies and valleys

Canopy: Swamp Gum; with Yellow Box, Narrow-leaf Peppermint and Manna Gum; occasional stands of Yarra Gum; 12–20 m tall and 10–20% cover

11.1. Box–Stringybark Woodland—hill-crest

Conservation status: regionally depleted

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: localised in YLAP B/E

Landforms: foothill—exposed hill-slopes and hill-crests

Canopy: Red Box–Red Stringybark; with Long-leaf Box; 10–15 m tall and 20–30% cover

11.2. Box–Stringybark Woodland—hill-crest/spur

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 34^a, 35^b

Distribution: formerly restricted in YLAP and PUAP; now mostly eliminated

Landforms: foothill—exposed hill-slopes, hill-crests and river spurs (Silurian sandstone); fragmented and degraded

Canopy: Yellow Box–Red Stringybark; with Long-leaf Box and Candlebark; 10–15 m tall and 20–30% cover

12.3. Box–Ironbark Woodland—spur/hill-crest

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 30^{ab}

Distribution: restricted in YLAP C

Landforms: river spurs and escarpments (Yarra River at Studley Park)

Canopy: Yellow Gum; 10–15 m tall and 15–20% cover

13.1. Escarpment Woodland—sheltered

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 27^b, 30^a, 34^a, 35^b

Distribution: restricted in YLAP

Landforms: sheltered escarpments of the Yarra and Plenty River

Canopy: Long-leaf Box–Manna Gum; with Red Stringybark, Yellow Box and Narrow-leaf Peppermint Manna Gum and Yellow Box (only at Studley Park); 15–20 m tall and 15–25% cover

13.2. Escarpment Woodland—exposed

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: restricted in YLAP

Landforms: exposed bluffs, spurs and escarpments of the Yarra and Plenty River

Canopy: Yellow Box; Manna Gum; 10–15 m tall and 15–20% cover

14.1. Grassy Woodland—volcanic plain

Conservation status: regionally threatened

Reference stands: nil

Relatively intact and extensive stands: 39^b

Partially intact or small stands: 39^a

Distribution: localised in YLAP C and PUAP B

Landforms: stony plains (Quaternary volcanics)

Canopy: River Red Gum; with Long-leaf Box and Yellow Box; 12–15 m tall and 10–20% cover

14.3. Grassy Woodland—alluvial plain

Conservation status: regionally threatened

Reference stands: 25^b, 35^b

Relatively intact and extensive stands: 25^a, 28^{ab}

Partially intact or small stands: 25^c, 26^a, 27^b, 30^{ab}, 33^c, 34^{ac}, 38^b

Distribution: formerly widespread in YLAP; restricted in PUAP B

Landforms: Tertiary sand-crests (Yarra Bend/La Trobe University), Quaternary plain-slopes and alluvial escarpments (Yarra)

Canopy: River Red Gum; with Yellow Box and occasional Swamp Gum and Manna Gum; 15–25 m tall and 10–25% cover

14.5. Grassy Woodland—plain-slope

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: localised in YLAP A/B/E where highly fragmented and degraded

Landforms: foothill—plain-slopes; degraded and fragmented

Canopy: Blakely's Red Gum; with River Red Gum, Long-leaf Box, Yellow Box, Red Box and Candlebark; 15–20 m tall and 10–20% cover

14.6. Grassy Woodland—valley

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 35^b, 36^f

Remnant, degraded or establishing stands: 27^{ab}, 33^{ac}, 34^a, 35^a, 36^{a-g}

Distribution: formerly widespread in PUAP A where highly fragmented and degraded; restricted in YLAP B/D/E

Landforms: foothill—broad exposed valleys

Canopy: Yellow Box–Candlebark; with Long-leaf Box and Red Stringybark; 15–20 m tall and 20–30% cover

15.1. Sand-plain Woodland

Conservation status: regionally threatened/disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 25^a, 34^{ad}

Distribution: disjunct in YLAP A/E

Landforms: Tertiary sand-plain

Canopy: Hill Manna Gum; with Long-leaf Box and Yellow Box; 10–15 m tall and 20–30% cover

16.1. Floodplain Riparian Woodland—billabong

Conservation status: regionally threatened

Reference stands: 32^b

Relatively intact and extensive stands: 31^{ac}, 33^c

Partially intact or small stands: 34^a

Distribution: restricted in YLAP

Landforms: billabongs of the Yarra River

Canopy: River Red Gum; 15–20 m tall and 10–20% cover

16.2. Floodplain Riparian Woodland—riverbank

Conservation status: regionally threatened

Reference stands: 34^{ad}

Relatively intact and extensive stands: 30^a, 34^c

Partially intact or small stands: 27^b, 31^{abc}, 32^{ab}, 33^{bc}, 34^b, 35^b

Distribution: restricted in YLAP

Landforms: riverbanks (Yarra River and lower reaches of the Plenty River)

Canopy: River Red Gum; with Yellow Box; 15–20 m tall and 15–20% cover

16.3. Floodplain Riparian Woodland—river terrace

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 31^{ac}, 32^{ab}, 33^c, 34^{acd}, 35^b

Distribution: restricted in YLAP

Landforms: river terraces of Yarra River and lower Darebin Creek

Canopy: River Red Gum; 15–20 m tall and 10–20% cover

16.4. Floodplain Riparian Woodland—riverbank

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 27^{ab}, 38^b, 39^{ab}

Distribution: restricted in YLAP B and PUAP B

Landforms: riverbanks (Plenty River)

Canopy: Manna Gum; 15–20 m tall and 10–20% cover

16.5. Floodplain Riparian Woodland—river terrace

Conservation status: regionally depleted

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: restricted in YLAP B where degraded

Landforms: river terraces (lower Plenty River)

Canopy: Manna Gum; with Long-leaf Box and Yellow Box; 15 m tall and 15–20% cover

16.6. Floodplain Riparian Woodland—creek

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: restricted in YLAP D where degraded

Landforms: creeks (lower Darebin Creek)

Canopy: River Red Gum; 15 m tall and 10–20% cover

17.1. Swamp Scrub—billabong/river flat

Conservation status: regionally threatened/disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 31^b, 39^a

Distribution: formerly widespread in PUAP B and YLAP D; eliminated from PUAP A

Landforms: stream floodplains and river billabongs and backswamps

Canopy: Swamp Paperbark; with Burgan and emergent River Red Gum, Swamp Gum and Manna Gum; 5–8 m tall and 30–40% cover

18.1. Riparian Scrub—sedimentary rapids

Conservation status: regionally disjunct

Reference stands: nil

Relatively intact and extensive stands: 34^{ac}

Partially intact or small stands: 35^b**Distribution:** restricted in YLAP E**Landforms:** sedimentary river rapids**Canopy: Muttonwood;** with Tree Everlasting, Blackwood, Silver Wattle, Burgan, River Red Gum (emergent), Manna Gum (emergent) and Mountain Tea-tree; 5–8 m tall and 30–50% cover

18.2. Riparian Scrub—volcanic stream

Conservation status: regionally threatened**Reference or relatively intact and extensive stands:** nil**Partially intact or small stands: 30^a****Distribution:** restricted to the lower Merri Creek in YLAP C**Landforms:** volcanic stream**Canopy: Woolly Tea-tree;** with Tree Everlasting, Silver Wattle, Sweet Bursaria, River Red Gum (emergent) and White Crack Willow; 5–8 m tall and 30–50% cover

20.4. Cliff/Escarpment Shrubland—exposed

Conservation status: regionally disjunct**Reference stands:** nil**Relatively intact and extensive stands: 30^{ab}****Partially intact or small stands:** nil**Distribution:** restricted in YLAP**Landforms:** exposed river cliffs**Canopy: Golden Wattle–Black Wattle;** with Lightwood, Burgan and Wedge-leaf Hop-bush and emergent Yellow Gum and Yellow Box at Studley Park; 2–8 m tall and 20–30% cover

20.5. Cliff/Escarpment Shrubland—volcanic

Conservation status: regionally threatened**Reference, relatively intact and extensive or partially intact or small stands:** nil**Distribution:** restricted in YLAP C and PUAP B where degraded; eliminated from YLAP D**Landforms:** Quaternary volcanic cliffs**Canopy: Lightwood–Tree Violet;** with Black Wattle, Blackwood and Tree Bursaria and emergent River Red Gum, Long-leaf Box, Yellow Box and Hill Manna Gum; 2–10 m tall and 20–30% cover

25.1. Seasonal Wetland—freshwater meadow/alluvial plain

Conservation status: regionally disjunct**Reference stands: 33^c, 38^b****Relatively intact and extensive stands: 26^a****Partially intact or small stands: 34^c****Distribution:** localised in YLAP A (La Trobe Uni), YLAP D (Banyule Swamp) and YLAP E and PUAP B (Dunnetts Road Swamp)**Landforms:** shallow freshwater marsh

Character species: Rush Sedge–Common Spike-sedge–Austral Rush; with Common Sedge, Slender Spike-sedge, Veined Swamp Wallaby-grass, Common Tussock-grass, Waterwort, Slender Knotweed, White Purslane and River Buttercup; 0.5–1 m tall and 40–60%

25.4. Seasonal Wetland—floodplain herbfield

Conservation status: regionally disjunct

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 34^a

Distribution: disjunct in YLAP E (south of Montpelier Billabong)

Landforms: floodplain terrace swamp

Canopy: Tall Sedge–Soft Bog-sedge; with Common Spike-sedge, Common Love-grass, Common Tussock-grass, Swamp Isotome, Upright Milfoil and River Buttercup; 0.5–1 m tall and 40–60%; rare coastal variant of the foothills 25.5

25.5. Seasonal Wetland—floodplain herbfield

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 36^d, 37^a, 38^b, 39^a

Distribution: localised in PUAP A/B

Landforms: floodplain swamps and impoundments

Canopy: Common Tussock-grass–Tall Sedge; with Common Sedge, Common Spike-sedge, Hollow Rush, Joint-leaf Rush, Green Rush, Pale Rush, Streaked Arrow-grass, Veined Swamp Wallaby-grass, Australian Sweet-grass, Sword Tussock-grass (dominant near streams), Centella, Swamp Crassula, Varied Raspwort, Slender Knotweed, White Purslane and Upright Milfoil; 1 m tall and 60–80% cover; in some situations a disclimax understorey to cleared riparian forest, floodplain riparian woodland, swampy woodland or swamp scrub

25.6. Seasonal Wetland—billabong mudflat

Conservation status: regionally disjunct

Reference stands: 32^{ab}

Relatively intact and extensive stands: 31^a

Partially intact or small stands: 31^{ac}, 33^c

Distribution: restricted in YLAP D

Landforms: Yarra River billabongs

Character species: Creeping Knotweed–Matted Water Starwort; with Swamp Club-sedge, Austral Rush, Toad Rush, Common Blown Grass, River Swamp Wallaby-grass, Water-ribbons, Plains Joyweed, Spreading Sneezeweed, Upright Milfoil, Small Loosestrife, Pale Knotweed, Small Knotweed and Waterwort; 0.2–1 m tall and 30–50% cover

25.7. Seasonal Wetland—emergent herbfield

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 26^a, 31^{ac}, 32^b, 33^c, 37^a, 38^b

Partially intact or small stands: 25^a, 32^a, 33^b, 34^{abc}, 36^d, 39^b

Distribution: restricted in YLAP and PUAP

Landforms: deep and shallow freshwater marshes at river billabongs (Yarra), floodplain swamps and artificial waterbodies (dams and reservoirs)

Character species: Common Reed–Cumbungi–Tall Spike-sedge; with Common Spike-sedge, Pale Rush, Floating Pondweed, Water-ribbons, Swamp Crassula, Upright Milfoil, Slender Knotweed and Small River Buttercup (Yarra); 0.5–3 m tall and 60–80% cover

26.1. Permanent Wetland—submerged/floating herbfield

Conservation status: regionally secure

Reference stands: 33^c

Relatively intact and extensive stands: 37^a, 38^b, 39^a

Partially intact or small stands: 26^a, 31^{ac}, 32^{ab}, 33^b, 36^d

Distribution: restricted in YLAP and PUAP

Landforms: shallow freshwater marshes at billabongs and natural floodplain wetlands (Banyule Swamp and Dunnetts Road Swamp) and deep and shallow freshwater marshes at artificial waterbodies (dams and reservoirs)

Character species: Blunt Pondweed–Pacific Azolla; with Riccia (*R. duplex*), Ferny Azolla, Lake Eel-grass, Common Duckweed, Many-fruit Tassel (PUAP B) and Yellow Bladderwort; 10–50% cover

27.1. Swampy Woodland—alluvial plain

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 36^{a-g}, 37^a, 38^a

Distribution: eliminated from PUAP A/B

Landforms: seasonally waterlogged flats on the floodplains of streams (formerly extensive areas associated with the Plenty River, Bruces Creek and Scrubby Creek upstream of Cades road, Yan Yean)

Canopy: Swamp Gum; with Blackwood, Yellow Box, Messmate, Candlebark and Narrow-leaf Peppermint; 12–15 m tall and 10–20% cover

Shrubs: Tree Everlasting, Hop Goodenia, Silver Wattle, Black Wattle, Burgan, Prickly Tea-tree, Swamp Paperbark, Prickly Currant-bush

Ferns and herbs: Austral Bracken, Tall Sedge, rushes, Common Tussock-grass, Weeping Grass, Spiny-headed Mat-rush.

28.1. Swampy Riparian Woodland—creek

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 36^{a-g}, 37^a

Distribution: restricted in PUAP A where reduced to remnant strata

Landforms: creeks (Plenty River tributaries upstream from Whittlesea including Bruces Creek, Plenty River East and West Branch and Scrubby Creek)

Canopy: Swamp Gum; with Black Wattle, Blackwood, Yarra Gum, Woolly Tea-tree and Swamp Paperbark; 12–15 m tall and 10–20% cover.

30.1. Drainage Line Woodland—plains

Conservation status: regionally threatened

Reference stands: nil

Relatively intact and extensive stands: 34^a, 35^b, 39^b

Partially intact or small stands: 25^{ab}, 32^b, 33^a, 34^{cd}

Distribution: restricted in YLAP and PUAP B

Landforms: creeks and drainage lines; degraded and fragmented

Canopy: **River Red Gum**; with Yellow Box, Swamp Gum and Narrow-leaf Peppermint (Hill Manna Gum on the Tertiary sand-plain at Westerfolds Park and occasional Yarra Gum and Lightwood, Black Wattle and Swamp Paperbark); 15–20 m tall and 10–20% cover

31.1. Valley Forest

Conservation status: regionally depleted

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 36^{bg}

Distribution: formerly restricted in the northern section of PUAP A where highly fragmented and degraded

Landforms: foothill—sheltered valleys

Canopy: **Yellow Box–Candlebark**; with Blackwood, Long-leaf Box, Red Stringybark, Messmate and Narrow-leaf Peppermint; 15–20 m tall and 25–40% cover

GEOLOGICAL and LANDFORM/SOIL TYPES of the Alluvial Plains

Silurian Siltstone/Mudstone

Distribution: YLAP B (east of Banyule Creek); YLAP D (east of Banyule Creek); YLAP E (associated with the Templestowe anticline west of Fitzsimons Lane)

Landform/Soil Types: hill-crests, exposed hill-slopes and river spurs and cliffs/shallow, stony brown gradational; sheltered hill-slopes/yellow duplex

Silurian Sandstone/Shale

Distribution: YLAP; PUAP

Landform/Soil Types: hill-crests, exposed hill-slopes and river spurs and cliffs and bluffs west of Yan Yean Reservoir/shallow stony, brown gradational; sheltered hill-slopes/yellow duplex with shallow sandy loam topsoil

Devonian Siltstone

Distribution: PUAP A (south-west of Toorourong Reservoir)

Landform/Soil Types: exposed hill-slopes/shallow yellow gradational; sheltered hill-slopes/yellow duplex

Devonian Volcanic Quartz-Feldspar

Distribution: YLAP A (south of the summit of Gresswell Hill)

Landform/Soil Types: volcanic plug/yellow duplex granitic sands

Tertiary River Alluvium

Distribution: YLAP A (flanking Gresswell Hill and Plenty Road at Larundel Hospital)

Landform/Soil Types: sand-plain/yellow duplex; disjunct outcrops of an ancient watercourse

Tertiary Marine Sand

Distribution: YLAP A (running south of Mont Park along Waiora Road to Ivanhoe); YLAP C (outcrops on Willsmere Hospital and the Par Three Golf Course)

Landform/Soil Types: sand-crest/yellow-red uniform sand (stranded coastal dune system referred to as the Red Bluff Sands of the Brighton Group); disjunct from the coastal plains nearer Port Phillip Bay

Quaternary Volcanics

Distribution: YLAP C (Yarra Bend); YLAP D (lower Darebin Creek and Yarra River behind La Trobe Golf Course)

Landform/Soil Types: stony rises and basalt escarpments/shallow red gradational; stony crests/brown uniform clay; stony plains/brown duplex: gilgai plains/grey-black duplex

Quaternary Colluvium

Distribution: YLAP; PUAP

Landform/Soil Types: Silurian formation outwash valleys and plain-slopes/yellow duplex with shallow grey loam topsoil; gullies and minor creeks/yellow gradational; broad valley flats and lower hill-slopes in the foothills of the ranges (PUAP A)/red duplex (peaty-loam topsoil derived from Devonian siltstone in areas of impeded drainage)

Quaternary Alluvium—floodplain/swamp

Distribution: YLAP A (Salt Creek); YLAP B (Plenty River and tributary floodplains); YLAP C (Yarra floodplain); YLAP D/E (Yarra floodplain, billabongs, Banyule Swamp and seasonal wetlands); PUAP A/B (Plenty River and tributary floodplains and Whittlesea/Yan Yean swamps)

Landform/Soil Types: stream floodplains/banks and creeks on Silurian formations/yellow gradational or organic uniform sandy loam along banks, yellow duplex (with deep, grey loam topsoil) on floodplains and grey or black cracking uniform clay in depressions.

YARRA LOWLAND ALLUVIAL PLAINS (YLAP)

Urban catchments of the lower Yarra River from Hawthorn to Eltham South and the lower reaches of its tributaries including the Koonung Creek, Diamond Creek and Plenty River.

Land-use

Past land-use: pastoral, orchards, market gardening and township/urban. Present land-use: Yarra Valley Park, urban and recreation (e.g. Yarra kayaking and fishing).

Native vegetation cover

Highly fragmented.

Key biological features

Baillon's Crake, Lewin's Rail, Little Bittern, Australasian Bittern, Latham's Snipe, Nankeen Night Heron, Barking Owl, Swift Parrot, Regent Honeyeater, Eastern Broad-nosed Bat, Southern Freetail Bat, Peron's Tree Frog, Pouched Lamprey, Short-headed Lamprey, Australian Grayling, Tasmanian Mudfish, Spotted Galaxias, Common Galaxias, Broad-finned Galaxias and Eltham Copper butterfly; grassy woodland, floodplain riparian woodland, box-ironbark (Yellow Gum at Yarra Bend Park), swamp scrub and seasonal wetland; faunal (particularly waterbird) rarity, abundance (primarily parrots and fish) and diversity and habitat rarity and abundance and diversity (both for grassy woodland at La Trobe University and Simpson Barracks); and strategic habitat link between the lowland hills and lowland alluvial plains (Diamond Creek/Yarra River).

Key areas/physical features for biota

Yarra Valley Park including Bolin Billabong and Westerfolds Park, Banyule Wetlands, Lower Eltham Park, La Trobe University/Gresswell Forest, Yarra River, lower Plenty River and lower Diamond Creek.

11 sites of significance: 4 state and 7 regional for fauna and 2 high, 8 medium and 1 unassessed for habitat.

YLAP A La TROBE UNIVERSITY AND MONT PARK

This management unit consists of one site of state faunal significance (site 26) and one of regional faunal significance (site 25) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 286223 (south point) to 7922 300247 (north point).

Location/Size: La Trobe University campus, Gresswell Forest, Larundel Psychiatric Hospital including the upper Strathallan Creek, Kingsbury Training Centre, Plenty Hospital, Mont Park Hospital, Macleod ridge and Cherry Street grassland, Gresswell Rehabilitation Centre including Gresswell Hill, Macleod Repatriation Hospital, Forensic Drive-Kingsbury Drive woodland and open space links. Approximately 350 ha.

Municipality: City of Darebin and City of Banyule (Macleod railway station).

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands at the meeting point of the Yarra Alluvial Plains to the south-east with the Plenty Volcanic Plains to the north-west and the Plenty Lowland Hills to the north-east.

Landforms

Alluvial plain: quartz-feldspar volcanic plug, sand-plain, plain-slopes, valleys, creeks and floodplains (associated with the Strathallan Creek and upper reaches of the Salt Creek) and moat system lakes and floodplain swamps (artificial freshwater marshes and meadows) at La Trobe University. Coastal plain: sand-crests. Volcanic plain: stony plains (Plenty Road at Kingsbury Drive). A diverse overlap of geological types associated with the alluvial, volcanic and coastal plains. Elevation is 50–120 m.

Hydrology

The Strathallan and Salt Creeks are fed from urban runoff. The lakes in the campus wildlife reserves were formed around 1970 and contain a deep freshwater marsh, shallow freshwater marshes and freshwater meadows.

Rainfall: 640–660 mm.

Site 25 Gresswell Forest–Strathallan–Hospitals

- Map Reference:** 7922 294228 (Cherry Street grassland); 7922 294240 (Gresswell Hill); 7922 299245 (Gresswell Forest); 7922 283225 (research and technology park woodland); 7922 290242 (Strathallan Habitat Link/golf course). One minute lat/long grids include 37°42' x 145°03' to 145°04' and 37°43' x 145°03' to 145°04'.
- Location/Size:** Approximately 230 ha.
- Municipality:** City of Darebin and City of Banyule (Macleod railway station).
- Land Tenure/Use:** Public: State; Office of Psychiatric Services (hospitals and Strathallan golf course); State Forensic Science Laboratory. Commonwealth; Macleod Repatriation Hospital (Veterans Affairs Department). Private: Urban Land Authority (Gresswell housing estate) and Science and Technology Park on Kingsbury Drive. The site was contained within the hospital grounds until land excisions in the 1960s for the building of La Trobe University and Macleod Technical School.
- Landforms:** Alluvial plain and coastal plain (see YLAP A). Elevation is 50–120 m.

Natural Heritage Values

Landscape. Cherry Street–Macleod Ridge–Gresswell Hill is rare in geological terms. It forms the only contact area in NEM of the Tertiary marine (Brighton Group) sands of the coastal plains and river alluvium of the alluvial plains. Proposed development at Cherry Street threatens to eliminate the last natural exposure of the Brighton sands in NEM (the other eliminated by recent development in the R&D Estate at La Trobe). The sand-belt and characteristic heathland flora and fauna occupied the south-eastern suburbs of Melbourne (e.g. Cheltenham heaths). The Devonian volcanic quartz-feldspar plug at Gresswell Hill is one of the most restricted and localised geological types in NEM. It only occurs elsewhere in NEM as small outcrops associated with the Yarra Fault between Warrandyte Gorge and Yering Gorge.

Scientific and Educational Values

Rehabilitation and management. See La Trobe University site 26.

Public interpretation. Gresswell Forest has a high public profile and usage. The reserve provides vital open space as well as an outdoor education centre on natural heritage.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: River Red Gum (alluvial plain) grassy woodland (14.3; Gresswell Forest)

Relatively intact and extensive stands: as above

Partially intact or small stands: River Red Gum (plains) drainage line woodland (30.1); Hill Manna Gum sand-plain woodland (15.1); Common Reed–Cumbungi–Tall Spike–sedge seasonal wetland (25.7)

Remnant, degraded or establishing stands: Swamp Gum gully woodland (10.3); Rush Sedge–Common Spike–sedge–Austral Rush seasonal wetland (25.1); Blunt Pondweed permanent wetland (26.1)

Vulnerable species: Matted Flax-lily

Rare species: Yarra Gum

Critical assemblages or populations: Alluvial Plain Grassy Woodland Critical Conservation Area. The grassy woodland extended from Bundoora through the eastern suburbs of Melbourne to south of Dandenong. Most has been cleared or severely modified by residential, rural and industrial development and the last remaining stands are now both depleted and fragmented. Gresswell Forest contains one of the largest, least fragmented and most intact stands of alluvial plain grassy woodland remaining in the inner Melbourne area (Carr 1983). The alluvial plain grassy woodland flora is diverse and ecotonal with River Red Gum (volcanic plain) grassy woodland to the west at Bundoora Park.

FAUNAL SIGNIFICANCE : Site 25 Gresswell Forest–Strathallan–Hospitals

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

25^a: 37°42' x 145°03'; Strathallan Habitat Link/Gresswell Hill

25^b: 37°42' x 145°04'; Gresswell Forest

25^c: 37°43' x 145°03'; Mont Park/Cherry Street/Kingsbury Drive

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 25^b: Swift Parrot

c. Rare fauna

Regional. 25^b: Barking Owl, Eastern Broad-nosed Bat, Broad-finned Galaxias

Regional. 25^c: Barking Owl, Yellow-bellied Sheathtail Bat

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 25^b: 7 species in Gresswell Forest including the White-bellied Cuckoo-shrike on 21 September 1987

g. Breeding parrots

Local. 25^a: 3 pair of Eastern Rosellas and 2 pair of Red-rumped Parrots in the old River Red Gums between Strathallan Golf Course and Strathallan Creek on 7 October 1987

h. Bats

Regional. 25^b: 7 species including the Eastern Broad-nosed Bat caught by mistnet and tripline at Gresswell Forest on 21 March 1989; 7 species including the Eastern Broad-nosed Bat, Southern Freetail Bat and Southern Forest Bat taken by harp trap at Gresswell Forest on 6 March 1991

l. Reptiles

Regional. 25^b: 7 species including the Blotched Blue-tongued Lizard, White's Skink, Large Striped Skink, Eastern Three-lined Skink and Tussock Skink at Gresswell Forest on 21 September 1987

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 25^b: over 100 species

b. Native birds

Regional. 25^c: 75 species. **25^b**: over 70 species

c. Native mammals

Regional. 25^b: 14 species

d. Herpetofauna

Regional. 25^b: 14 species

f. Butterflies

Regional. 25^a: 20 species at Gresswell Hill (Braby 1989)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 25^b: 15 species

Local. 25^c: 6 species. **25^a:** 5 species

b. Regionally endangered fauna (R1 species)

Regional. 25^b: 4 species. **Birds:** Dollarbird, White-bellied Cuckoo-shrike, Little Friarbird. **Mammals:** Eastern Broad-nosed Bat

Regional. 25^c: 1 species. **Mammals:** Yellow-bellied Sheath-tail Bat

c. Regionally vulnerable fauna (R2 species)

Regional. 25^b: 4 species. **Birds:** Barking Owl, Fuscous Honeyeater. **Mammals:** Southern Freetail Bat. **Fish:** Broad-finned Galaxias

Regional. 25^a: 1 species. **Birds:** Red-capped Plover

Regional. 25^c: 1 species. **Birds:** Barking Owl

d. Regionally rare fauna (R3 species)

Regional. 25^b: 1 species. **Birds:** White-browed Woodswallow

Regional. 25^c: 1 species. **Birds:** Collared Sparrowhawk

e. Regionally depleted fauna (R4 species)

Regional. 25^b: 6 species. **Birds:** Peregrine Falcon, Australian King-Parrot, Swift Parrot, Rufous Songlark. **Reptiles:** White's Skink. **Frogs:** Bibron's Toadlet

Regional. 25^a: 4 species. **Birds:** Buff-banded Rail, Latham's Snipe, White-winged Triller. **Butterflies:** Blue Jewel

Regional. 25^c: 3 species. **Birds:** Peregrine Falcon, Swift Parrot, White-winged Triller

f. Regionally restricted fauna (R5 species)

Regional. 25^b: 9 species. **Birds:** Great Egret, Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Spiny-cheeked Honeyeater. **Reptiles:** Large Striped Skink, Tussock Skink. **Frogs:** Striped Marsh Frog

Regional. 25^c: 9 species. **Birds:** Brush Bronzewing, Great Egret, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Spiny-cheeked Honeyeater

Local. 25^a: 6 species. **Birds:** Rainbow Lorikeet. **Reptiles:** Large Striped Skink, Tussock Skink. **Butterflies:** Meadow Argus, Dark Purple Azure, Chequered Blue

g. Nesting birds of prey/parrots

Regional. 25^c: Barking Owl (River Red Gum hollow on the Mont Park Hospital grounds in September 1987)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 25^a: 6 Latham's Snipe flushed from Strathallan Creek near the golf course on 7 October 1987

b. Rare or threatened fauna

Regional. 25^b: 20 Swift Parrots in Gresswell Forest on 21 September 1987

Outlook

Despite excellent restoration work at Gresswell Forest, the faunal significance may decline over the next decade to Regional Category 2 as habitat links are severed by proposed development. The ground fauna in the habitat refugia may be unable to cope with rising levels of human impact and disturbance.

FAUNA

Rare or Threatened Fauna

- Bb* **25^b: Swift Parrot.** Twenty observed in River Red Gum (alluvial plain) grassy woodland (14.3) at Gresswell Forest on 21 September 1987. They visit in early spring before departing for breeding grounds in Tasmania. During this time they feed primarily on River Red Gum buds and psyllid insects.
- Bc* **25^{bc}: Barking Owl.** Pair breeding in a hollow in an old River Red Gum (remnant alluvial plain grassy woodland; 14.3) in the Mont Park Hospital grounds on 7 October 1987. The owl had been heard calling at Gresswell Forest in July 1987. One was also seen in the woodland strip between Mont Park and La Trobe University in April 1994 (George Paras pers. comm.). The species has not been recorded on the university campus nor in the residential area of Macleod. The reasons for the apparent confinement to the Gresswell–Mont Park area are the abundance of prey (Common Ringtail Possums and rabbits) and the low night level of human activity and disturbance. Sugar Gliders may also be occasional prey at Gresswell Forest. Ringtails are less common on the university campus due to a combination of cat predation (high population) and competition from Common Brushtail Possums whose high population is maintained by ample food scraps, available roost sites and the high incidence of released animals.
- Bc* **25^c: Yellow-bellied Sheathtail Bat.** One seen at Heidelberg Heights on 2 April 1990. There are no other records for GM since 1986, but there were several in the 1970s. The Yellow-bellied Sheathtail Bat is the largest of Victoria's insectivorous bats. It is usually high flying and eludes harp traps and mistnets. Little is known of the distribution in southern Victoria. Most observations have been from March to May from the central coast around Melbourne. The range of the species outside Victoria is characteristically tropical and sub-tropical (Torresian) and extends over the northern half of the continent and the eastern coast of New South Wales.

Strahan (1988) suggests that individuals recorded in southern Australia are in the course of an autumn–winter migration. They spend winter and spring in northern Australia where they breed in summer, before dispersing southwards. There is some similarity with this pattern of movement to that of the White-throated Needletail and Fork-tailed Swift. Over summer and early autumn these birds gradually move from northern to southern Australia following the southward shifting pressure systems and bodies of warm air. The possible route for the Yellow-bellied Sheathtail Bat is down the east coast of New South Wales, reaching the cooler latitudes of the south coast by autumn. From here they probably complete the circuit back to northern Australia by the end of the wet season.

The Yellow-bellied Sheathtail Bat has an audible echolocation and can be recognised under spotlight by its light belly, slow wing beat and straight flight path. Stomach content analyses in northern Australia record beetles as the main prey items. The presence of grasshoppers indicates they also feed close to the ground. The bat found at Heidelberg Heights was in poor condition and was well below normal body weight (Lindy Lumsden pers. comm.). It had no sign of external injury and rapidly regained weight in captivity. Cool and dry autumns such as 1990 when prey are scarce may run down their body reserves to below an operative level, causing some to perish.

- Bc* **25^b: Broad-finned Galaxias.** Two were located when the central billabong at Gresswell Forest was drained in February 1996 (George Paras pers. comm.). To get there from the Yarra, the galaxias needed to pass through a lengthy section of underground barrel drain between Macleod and Gresswell.

Other Significant Fauna

Birds

- Eb* **25^b: Dollarbird.** One visited for a few days in December 1989 (George Paras pers. comm.). At the time it was also seen at La Trobe University.
- Eb* **25^b: White-bellied Cuckoo-shrike.** A pair was breeding in River Red Gum grassy woodland (14.3) at Gresswell Forest on 21 September 1987. All five records of the species in GM were from grassy woodland.
- Eb* **25^b: Little Friarbird.** One observed at the Greenwood Drive entrance of Gresswell Forest in a Yellow Box (River Red Gum grassy woodland; 14.3) in January 1996 (George Paras pers. comm.). The species had been recorded nearby at the La Trobe Campus Wildlife Reserve in the 1970s.

- Ec* **25^a: Red-capped Plover.** A pair nested (eggs laid) above the eastern shoreline of the ULA stormwater wetlands at Wattle Avenue in November/December 1995 (Bruce Smith pers. comm.). The wetlands support developing Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7). The eggs were trampled by humans and the birds were disturbed by dogs. This is the only record in NEM and one of few away from coastal saltmarsh in GM. The species had been recorded nearby at the La Trobe Campus Wildlife Reserve wetlands in the 1970s.
- Ec* **25^b: Fuscous Honeyeater.** One observed in River Red Gum grassy woodland (14.3) at Gresswell Forest on 21 September 1987.
- Ee* **25^a: Latham’s Snipe at upper Strathallan Creek.** Six were flushed from the section near the golf course on 7 October 1987. Small numbers annually visit the area from September to January. They shelter amongst dense rushes and sedges along the creek during the day. They feed at night in the seasonal floodplain herbfield, including areas on the golf course. Disturbance from adjoining subdivision in recent years has reduced the visitation rate of snipe.
- Ee* **25^a: Buff-banded Rail.** One amongst Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) at the south entrance pondage of the Strathallan Habitat Link in May 1996 (Bruce Smith pers. comm.).
- 25^c: Birdlist for the red gum area of Macleod.** A list of 74 native species for the Cherry Street area was kindly provided by Reg Johnson. Significant species included the Great Egret, Little Eagle, Australian Hobby, Peregrine Falcon, Barn Owl, Swift Parrot, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, White-winged Triller and Spiny-cheeked Honeyeater. An additional five species were from the period 1977 to 1985. These were the Glossy Ibis, Leaden Flycatcher, Gilbert’s Whistler (1982 drought vagrant), Bassian Thrush and Regent Honeyeater.

Mammals

- Ec* **25^b: Southern Freetail Bat.** Nine species of insectivorous bats were recorded from trapping efforts at Gresswell Forest on 21 March 1989 and 6 March 1991 (7 species on each occasion). The Chocolate Wattled Bat, Eastern Broad-nosed Bat, Southern Forest Bat and Southern Freetail Bat have not been recorded elsewhere within a 15 km radius of Melbourne’s CBD. Mature River Red Gums throughout the site and at La Trobe University are well over 150 years old. The bat diversity is due to the extent of the woodland and the number of tree hollows.

Reptiles and frogs

- Ee* **25^b: White’s Skink and Bibron’s Toadlet at Gresswell Forest.** A single White’s Skink was recorded under River Red Gum grassy woodland (14.3) in 1986 (Grant Turner pers. comm.). The Bibron’s Toadlet was recorded along the drainage line under River Red Gum (plains) drainage line woodland (30.1) on 21 March 1989.
- Ef* **25^{ab}: Large Striped Skink and Tussock Skink.** These inhabit the grasslands under River Red Gum grassy woodland (14.3) at Gresswell Forest and upper Strathallan Creek and the quartz–feldspar and Tertiary gravel conglomerates at Gresswell Hill (Hill Manna Gum sand-plain woodland; 15.1). Both are infrequently recorded away from the Quaternary volcanics. The Large Striped Skink is locally common at Gresswell Forest.
- 25^c: Tree Dragon.** Located on the Tertiary marine sand under River Red Gum grassy woodland (14.3) west of Macleod Technical School on 9 April 1990. This area was sold by the university and has been since cleared for the R&D science and technology park. This was the last population of Tree Dragons in the management unit and one of the last surviving in inner Melbourne. The dragons appear to have been eliminated by the R&D estate. A survey of the woodland remnants to the west should be conducted. If a small population survives, the area needs to be protected (e.g. provide ground logs).

Butterflies

- 25^a: Gresswell Hill.** The hill-top forms a butterfly study site (Braby 1989). Twenty species were recorded including the Meadow Argus, Dark Purple Azure, Chequered Blue and Blue Jewel.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Partially intact habitat link to the La Trobe University site. Links for birds to Bundoora Park and Simpson Barracks.

Other important habitat links. A link occurs from Strathallan Creek to the east across Gresswell Road to Gresswell Hill and thence south through Macleod Ridge and Cherry Street grassland to Macleod railway station. This will be partly blocked by new housing development along Gresswell Road. A link occurs west back to the university campus via the Forensic Drive area and woodlands north of the Waterdale Road and Kingsbury Drive intersection. McMahon (1990) stated that there is a need to strengthen and revegetate the westerly link to public open space areas outside the Mont Park complex (i.e. Larundel Hospital, Kingsbury Training Centre and Bundoora Park). Avifauna movement through the Strathallan residential development to these areas needs to be enhanced by retaining remnant River Red Gums and stands of native grassland and shrubland. Through natural regeneration and strategic planting, bands of native vegetation should pass through public open space in the residential area providing habitat links for native fauna. The promotion of indigenous streetscape and garden planting within the residential area would complement the habitat link. Indigenous plants can be obtained from the La Trobe University Wildlife Reserve plant nursery.

Fragmentation, loss of diversity of faunal populations and dieback of River Red Gums. Loss in River Red Gum grassy woodland cover near Melbourne has reduced and fragmented the populations of most of its native fauna species. Dieback of River Red Gums, and more particularly sapling trees, resulting from urban encroachment is of great concern. Healthy trees containing full-leaved crowns with few dead or leafless branches, little epicormic growth and minimal insect grazing damage are rare.

Dominance of aggressive native and alien birds due to urban settlement. Linear habitat links or fragmented and thinned stands in the site are largely occupied by open-space and forest-edge-inhabiting species (e.g. Noisy Miners). Disturbance and loss of habitat from further urban subdivision will increase the degree of internal fragmentation and render a disproportionately high 'edge' to 'interior' habitat area ratio. This will cause population declines and raise the level of management needed to address these declines.

Habitat patches adjacent to areas dominated by human activity are subjected to high levels of disturbance (Taylor 1987). This produces a situation where the whole patch is perpetually disturbed and so becomes like an edge. Faunal assemblages in disturbed edges are not ecologically equivalent to those found in natural successions within interior vegetation. Perpetual disturbance prevents faunal succession beyond early, colonising stages and favours aggressive alien open-space species such as the Common Myna and Common Starling.

Strengthen habitat links. The ultimate biological value in a fragmented site rests on the strength of its habitat links. There is an urgent need to re-establish a network of habitat links between fragmented stands of grassy woodland in the site. This would ameliorate the present detrimental effect on wildlife populations.

Many of the remnants, considered individually, have already become too small, fragmented or isolated or have too few management options to be effective in conserving the complete assemblage of flora and fauna that existed before the surrounding native vegetation was cleared. Considered collectively, these remnants still contain significant species, such as the Barking Owl, which are now nearly extinct in urban Melbourne. This owl occupies a large home range and is probably dependent on most of the area of River Red Gums in the northern section of the site. The prey potential and nest sites provided by remnant trees in secluded areas such as the Strathallan Habitat Link add to the carrying capacity of the site for the Barking Owl.

Unfragmented woodlands contain a higher species richness and density of insectivorous birds than fragmented, thinned or isolated remnants (Beardsell 1989, Bennett 1991). Revegetation and appropriate conservation management of the Strathallan Habitat Link and the retention of the golf course (including replanting sections with indigenous vegetation) as a habitat buffer, would guarantee River Red Gums within the link a greater level of protection from dieback.

Loss of habitat-specialist or forest-dependent species of birds. The open space species compete with beneficial forest-dependent birds such as Spotted Pardalotes and exert a marked effect on the ecology of other forest birds (Loyn 1985a, Loyn 1987, Beardsell 1989, Bennett 1990). Much of the pardalote's breeding habitat along creek banks in the site has been eliminated or degraded by erosion and weed invasion caused by the construction of barrel-drains and culverts. This lack of breeding habitat in tandem with losses suffered from tree clearing and stand fragmentation has greatly reduced the population of resident Spotted Pardalotes. The species is now predominantly a non-breeding winter visitor. Species dependent on later successional stages such as parrots, which require mature tree-hollows, fail to compete successfully for hollows with alien hollow-nesting species. Similarly, high order predators such as the Barking Owl, which are rare to begin with, are eliminated as they cannot find adequate prey or secure cover in fragmented habitats.

Habitat loss and disturbance from housing development. Additional loss will occur with the development of the Gresswell Rehabilitation Centre and potential development of the Macleod Repatriation Hospital. Housing currently increasing along Gresswell Road will limit the movement of fauna between the Strathallan Habitat Link and Gresswell Hill. Prior habitat loss has fragmented the grassy woodland stands. This has led to an increased River Red Gum dieback and mortality rate and a decreased rate of tree regeneration. Some avifauna species, particularly forest-dependent insectivores which mediate eucalyptus dieback, have been reduced or eliminated. Surviving populations have a poor prospect of long-term survival. Once dieback is initiated and land-use intensifies its effects accelerate rapidly, potentially culminating in widespread tree death. Development at Mont Park will result in increased habitat disturbance. This is likely to lead to weed and vermin invasion of the La Trobe University Wildlife Reserves and elimination of native flora and fauna species.

Corridors maintain natural linkages for native flora and fauna between isolated habitat patches (Bennett 1991). A likely corridor exists at Strathallan (see below) as it acts as a 'stepping stone' for relatively sedentary species or forest-dependent fauna such as the Spotted Pardalote. These have been observed moving between Gresswell Forest and the Campus Wildlife Reserve. Strathallan and the network of other habitat links operating within the site are likely to facilitate faunal movement and dispersal ability into nearby stands isolated by development (e.g. Simpson Barracks site) from larger areas of native woodland in the Yarra Valley and Plenty Valley.

Require increased conservation management and habitat link restoration. This is critical on the hospital land to counterbalance deleterious effects arising from existing and proposed development. Proposed development along Cherry Street will cause further severance of habitat links to Macleod Park, downstream along Salt Creek and across the residential area to Simpson Barracks. The woodland ecosystem is under intense pressure from disturbance and fragmentation. This is being expressed in the acute dieback problem of River Red Gums along the old railway easement.

Consolidation of the River Red Gum woodland into a conservation area

Meredith (1989) recommended that a coordinated management strategy of the whole Mont Park area would maximise its values and viability and that a consultative committee should be established with the La Trobe University Wildlife Reserves group as lead agency in vegetation restoration and fauna management. Avifauna studies in the Plenty Valley indicated that stands of the size and condition of those remaining in the La Trobe University–Mont Park–Gresswell Forest area have the potential to support viable populations of species in the long term provided effective habitat links are retained and appropriate conservation management is undertaken (Beardsell 1989). The long-term viability of the site depends on it being protected from further fragmentation. This is the largest and most significant stand of River Red Gum on public land in GM and one of the largest and most intact in GM. The public land area containing River Red Gum should be designated a River Red Gum Conservation Area.

Management plans and issues of the red gum woodland and habitat links. A specific management plan for the Strathallan Habitat Link as part of an overall conservation strategy conducted in line with those already in operation at the La Trobe University Wildlife Reserves would greatly enhance the biological integrity of the site. Management issues raised by Meredith (1989) and McMahon (1990) to be dealt with in the hospital areas, habitat links and abutting private allotments include:

- Restricting earthworks and development near areas of biological significance
- Establishing habitat buffer areas between existing or proposed development and areas of biological significance
- Stopping disturbance and rubbish dumping in areas of significant habitat
- Starting weed control programs
- Improving levels of water turbidity and retarding runoff and effluent
- Protecting all indigenous vegetation from clearing, cutting and removal
- Starting an indigenous revegetation program
- Revegetating habitat links to reduce habitat fragmentation, particularly indigenous understorey species
- Increasing controls on domestic and feral cats and roaming dogs
- Adopting a discretionary mowing regime (e.g. leaving unmown blocks, containing slashed or grazed perimeter fire-breaks) to promote natural regeneration
- Introducing a mosaic ecological burning regime to maintain habitat diversity and lower the fire risk associated with the cessation of broad-scale mowing.

Strathallan Habitat Link and the Regional Habitat Link Strategy

Strathallan Habitat Link. (As proposed by Stuwe & Horrocks (1988). This is an area of about 1000 m NE/SW and 150 m NW/SE (17.6 ha). It is separated from the Strathallan golf course and Wattle Avenue by a farm fence so as to provide free-range area and faunal exchange between the Campus Wildlife Reserve (28 ha) and Gresswell Forest (50 ha). The habitat link has a formal trail including board-walks over the marshland near Wattle Avenue.

Importance of the Strathallan Habitat Link for connectivity of fauna between La Trobe and Gresswell. The concept of the importance of the habitat link in assisting the maintenance of species diversity and genetic flow between the biologically significant Gresswell Forest and Campus Reserve is well established (e.g. Carr 1983, Stuwe & Horrocks 1988, Carr & McMahon 1988, Meredith 1989, McMahon 1990). Its development for conservation is the key to the remaining habitat link network within the site. The viability of the Strathallan Habitat Link is pivotal to the local survival in the long-term of species such as the Sugar Glider. This in turn would benefit nocturnal birds of prey such as the Barking Owl. The ecological requirements determining the survival of species lie in delicate balance.

Wattle Avenue forms a physical barrier to wildlife movement between the La Trobe University Campus Reserve and Gresswell Forest (Meredith 1989). The road is also considered to be a continual source of noise disturbance, weed invasion and polluted runoff which already seriously compromises the conservation values of the downstream campus reserve. Continuity of the ground habitat link has been partly achieved by the construction of a frog tunnel under Wattle Avenue.

Strathallan golf course as a habitat buffer. Stuwe & Horrocks (1988) proposed an additional habitat buffer area on the golf course to the west. This has more effectively screened the Strathallan Habitat Link from the Gresswell housing estate. Retaining the golf course as a habitat buffer has increased the habitat area and the diversity, density and viability of fauna in the habitat link. This will increase its effectiveness for wildlife conservation as a viable habitat patch as well its effectiveness as a habitat link between the more substantial woodland stands at Gresswell Forest and the Campus Wildlife Reserve. A broader link will provide cover, feeding and breeding opportunities for forest-dependent species which cannot reside in linear corridors. It will also provide additional habitat for beneficial vertebrate and invertebrate species which help to control pest invertebrates (especially eucalyptus dieback agents) and promote a more balanced native ecosystem.

Strathallan Habitat Link—raising habitat and water quality. Revegetation of grassy woodland and wetland in the Strathallan Habitat Link has begun. The surrounds of the adjoining ULA stormwater wetlands are also being replanted. This will greatly enhance the intrinsic biological value of the habitat link. The increased area and diversity of wetland habitat along Strathallan Creek will provide a broader ‘filtering zone’ for effluent, stormwater and roadway runoff and hard rubbish input (e.g. polystyrene boxes and plastic bags and bottles) from upstream sources. This should improve the level of water quality entering the campus reserve. Regenerating and replanting native ground flora and re-establishing cover (e.g. replacing logs) would provide for dispersal of ground fauna, particularly the lizard and frog species present.

 Other Issues

Visitor use pressure and fires at Gresswell Forest.

Pet restraints and controls. With enhancement of the Strathallan Habitat Link, species such as the Sugar Glider will be able to move between Gresswell Forest and the Campus Wildlife Reserve. The survival of Sugar Gliders may depend on reducing the numbers of feral cats and applying pet restraints such as evening curfews on domestic cats in adjacent residential areas (see Meredith 1989).

Management of Gresswell Forest and community involvement. Gresswell Forest was excised from the hospital land into the Wildlife Reserves at much at the same as the Eastern Extension (1976). The chain mesh fence enclosing the reserve was erected the following year. For the first few years Gresswell was managed by the Core Area ranger. Vandalism and fires had become a major problem. The appointment of a full-time ranger in 1979 helped resolve the conflict through public relations exercises. Community involvement and their increased awareness of the natural values of the bushland has been the key to the success of Gresswell Forest.

Planning Recommendations

Alluvial Plain Grassy Woodland Critical Conservation Area.

Green web park. The Campus Wildlife Reserves when joined to Gresswell Forest through the Strathallan Habitat Link should become resourced and serviced as a major Green Web Park.

Site 26 La Trobe Campus Wildlife Reserves—Moat System

Map Reference:	7922 285237 (La Trobe University Campus Wildlife Reserve). One minute lat/long grids include 37° 43' x 145° 03'.
Location/Size:	Approximately 60 ha.
Municipality:	City of Darebin.
Land Tenure/Use:	Public: La Trobe University (Commonwealth). The Mont Park dairy farm occurred on the university site before the commencement of building in the mid-1960s. Wildlife reserves have been developed on the Strathallan Creek floodplain which have undergone extensive habitat restoration works. An artificial moat system has been developed where the creek flows through the central university campus.
Landforms:	Alluvial plain (see YLAP A). Elevation is 70–90 m.

Natural Heritage Values

Landscape. A long-term indigenous revegetation program of the wetlands and grassy woodland in the Campus Wildlife Reserve Core Area and Eastern Extension has provided high natural heritage and landscape values, as do the mature campus River Red Gums.

Scientific and Educational Values

Scientific reference. Biological research field station and post-graduate study site.

Rehabilitation and management. The habitat restoration and revegetation at La Trobe was a pioneer program in metropolitan Melbourne. The campus reserve wetland complex encompasses an area of over 10 ha. Many thousand indigenous plants have been propagated and established. Seeds and cuttings were collected locally, including woodland/riparian species from the Plenty Gorge and wetland species from the Yarra River floodplain. The collecting/replanting was commenced in 1974 and still continues. Many regionally significant plant species have been re-established in the wetlands which now comprise the most diverse wetland habitat in the Yarra Lowland Alluvial Plains.

Public interpretation. The campus reserve is a scientific research area and as such is closed to general public access. Guided tours and community programs are frequently conducted. It has been used as a model for habitat restoration and protection works for other revegetation projects such as at Darebin and Warringal Parklands.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Relatively intact and extensive stands: Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1; Eastern Extension Swamp); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7; campus reserve lakes, particularly Small Lake)

Partially intact or small stands: River Red Gum (alluvial plain) grassy woodland (14.3); Blunt Pondweed–Pacific Azolla–Yellow Bladderwort permanent wetland (26.1)

Remnant, degraded or establishing stands: River Red Gum (plains) drainage line woodland (30.1)

Notable features: one of the most extensive and intact permanent/seasonal wetland systems in the Yarra Lowland Alluvial Plains has been established in the Wildlife Reserve Core Area and Eastern Extension. Over 150 plant species, particularly semi-aquatic plants, have been re-established.

FAUNAL SIGNIFICANCE: Site 26 La Trobe Campus Wildlife Reserves–Moat System

Assessment: State—Category 1 (B, D, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

26^a: 37° 43' x 145° 03'; La Trobe Campus Wildlife Reserves—college parklands

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 26^a: Regent Honeyeater (two sightings)

b. Vulnerable fauna

State. 26^a: Swift Parrot, Dwarf Galaxias (established)

c. Rare fauna

State. 26^a: Baillon's Crake, Little Bittern, Grey Goshawk, Black Falcon, Powerful Owl,

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 26^a: 28 species (179 individuals) in a three-hour avifauna count of the campus reserve and moat system floodplain on 20 December 1986

d. Breeding waterfowl

Regional. 26^a: 6 species on the avifauna count of 20 December 1986

e. Honeyeaters

Unranked. 26^a: 10 species in ornamental native plantation on the Glenn/Menzies College lawns on 10 May 1987

f. Breeding migratory insectivores

Regional. 26^a: 9 species including the Fan-tailed Cuckoo, Horsefield's Bronze-Cuckoo, Sacred Kingfisher, Tree Martin, White-winged Triller, Rufous Songlark, White-browed Woodswallow, Dusky Woodswallow and Olive-backed Oriole in River Red Gum grassy woodland (14.3) on 20 December 1986

g. Breeding parrots

Regional. 26^a: 5 species including the Little and Musk Lorikeets and Red-rumped Parrot on the avifauna count of 20 December 1986

k. Frogs

Regional. 26^a: 7 species including the Growling Grass Frog, Striped Marsh Frog and Verreaux's Tree Frog at the wildlife reserve wetlands on 20 December 1986

l. Reptiles

Local. 26^a: 5 species including the Tussock Skink and Eastern Three-lined Skink at the wildlife reserve on 20 December 1986

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 26^a: 163 species

b. Native birds

State. 26^a: 133 species

c. Native mammals

Regional. 26^a: 10 indigenous and 3 released which have established but are not included (the third being the Swamp Rat which possibly survives; see fauna)

d. Herpetofauna

Regional. 26^a: 20 species: 11 indigenous reptile (5 released species not included) and 9 frog species

f. Butterflies

Regional. 26^a: 20 species (Braby 1989)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 26^a: 31 species

b. Regionally endangered fauna (R1 species)

State. 26^a: 4 species. **Birds:** Grey Goshawk, Dollarbird, Tawny-crowned Honeyeater, Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

State. 26^a: 9 species. **Birds:** Baillon's Crake, Spotless Crake, Little Egret, Little Bittern, Black Falcon, Azure Kingfisher, Black-eared Cuckoo, Red-capped Robin, Fuscous Honeyeater

d. Regionally rare fauna (R3 species)

Regional. 26^a: 6 species. **Birds:** Australian Spotted Crake, Darter, Hardhead, Musk Duck, Little Corella, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

State. 26^a: 12 species. **Birds:** Buff-banded Rail, Latham's Snipe, Swamp Harrier, Peregrine Falcon, Powerful Owl, Swift Parrot, White-winged Triller, Rufous Songlark. **Mammals:** Platypus, Swamp Rat (reintroduced). **Frogs:** Bibron's Toadlet. **Butterflies:** Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 26^a: 23 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, Spiny-cheeked Honeyeater. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Cunningham's Skink, Delicate Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Meadow Argus, Dark Purple Azure

g. Nesting birds of prey/parrots

Regional. 26^a: Australian Hobby (stick nest in a Spotted Gum on Main Drive); Little Lorikeet (River Red Gum hollow near Chisholm College)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 26^a: Latham's Snipe (16 at the Eastern Extension Swamp on 20 December 1986)

b. Rare or threatened fauna

State. 26^a: Dwarf Galaxias (several thousand in the Eastern Extension Ponds)

c. Waterfowl

Regional. 26^a: 112 birds (11 species) in a three-hour avifauna count of the campus reserve and moat system floodplain on 20 December 1986

l. Regionally vulnerable fauna (R2 species)

Regional. 26^a: 10 Fuscous Honeyeaters in the Glenn/Menzies College plantations on 10 May 1987

n. Regionally depleted fauna (R4 species)

Regional. 26^a: Swift Parrot (6 in the Glenn/Menzies College plantations on 10 May 1987; this is artificial habitat and it is not assessed under *Fb*)

Outlook

In the 1970s the site was State Category 3 and the most significant feature was the spring–summer population of Latham’s Snipe on the floodplain. About 10 years into the wetlands revegetation program (circa 1984), this moved to Category 2 as new criteria were met by waterbirds. About 10 years further on (circa 1994), this moved to Category 1. This balance should remain under present management as wetland and grassy woodland fauna are recruited and habitat link dependent species such the Regent Honeyeater become locally extinct.

FAUNA

Rare or Threatened Fauna

- Ba* **26^a: Regent Honeyeater.** Two birds in a small stand of Yellow Box in the central section of the campus reserve on 16 December 1989 and a single bird near Strathallan Creek downstream of Wattle Avenue in January 1990 (George Paras pers. comm.). The Yellow Box were planted in the late 1970s. The occurrences of the honeyeater are treated as vagrant, but are designated with State significance given there were two sightings.
- Bb* **26^a: Swift Parrot.** Six birds in flowering Bangalays in the Glenn/Menzies College plantations on 10 May 1987.
- Bc* **26^a: Baillon’s Crake and Little Bittern.** Both recorded in Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at the Small Lake. The bittern on 20 December 1986 and the crake on 16 December 1989.
- Bc* **26^a: Grey Goshawk.** Two birds in the wildlife reserve on 28 March 1993 (George Paras pers. comm.). One was grey plumaged and the other was white. Sightings during the survey period have been made elsewhere in the district at Janefield and Banyule Flats. These were each in early autumn, suggesting that the lower Plenty River may be a dispersal route for birds between their spring/summer breeding grounds (e.g. Toorourrong Reservoir and Diamond Creek Headwaters) and winter feeding grounds (e.g. along the coast). The Grey Goshawk was recorded at the wildlife reserves on several occasions during the 1970s. The nine locality sightings made in NEM constitute a significant proportion of the recent documented sightings of the species in Victoria.
- Bc* **26^a: Black Falcon.** The falcon was seen in River Red Gum grassy woodland (14.3) at the south-east corner of the campus reserve in late 1995 (George Paras pers. comm.).
- Bc* **26^a: Powerful Owl.** Juvenile roosting in a tree at the northern end of the Martin Building near the moat at around 2100 hours on 13 April 1994 (Rudy Frank of the Archaeology Dept; information forwarded by George Paras).

Critical Assemblages or Populations

Bb/Fb **26^a: Dwarf Galaxias.** Three hundred were translocated in 1993/94 from Dandenong Creek to the Eastern Extension Ponds under FFG Act and Fisheries Act permits with the Department of Natural Resources and Environment (George Paras pers. comm.). A Land-owner Permit with Melbourne Parks & Waterways to remove them was also required. This species is regionally endangered in Greater Melbourne where it is known to survive naturally only in the middle Dandenong Creek (locally threatened by Mosquito Fish). It is listed vulnerable in Victoria.

The galaxias soon established and commenced breeding. They are considered to be an annual species, depositing eggs on submerged vegetation in temporary freshwater marshes. Adaptation to this environment includes a high tolerance of low dissolved oxygen (by gulping air) and an ability to aestivate for up to five months in mud burrows or crab-holes and to cross overland provided a connecting film of water is present (Koehn & O’Connor 1990).

The translocation was conducted in accordance with FFG Action Statement and Recovery Plan recommendations for the species. This was to establish populations in other suitable areas within the accepted range. The population of Dwarf Galaxias in the Eastern Extension Ponds is possibly the most extensive and secure in GM and is of critical importance to its regional conservation. The species is suitable for re-introduction into shallow, well-vegetated wetlands at the head of small drainage systems. It is critical that the wetlands do not support Mosquito Fish, which predate on eggs and fry. Translocation of stock from this population under new permit into the Morang Wetlands at Plenty Gorge Park would be desirable (e.g. Wilton Vale Marsh in site 40). The suitability of wetlands with regard to habitat (particularly submerged herbfield) and water quality needs to be scientifically assessed before application for stock should be made.

Other Significant Fauna

Birds

Cb 26^a: Waterbirds. Twenty eight species (179 individuals) including 11 waterfowl species (112 individuals) recorded in a three-hour waterbird count along the moat system and middle Strathallan Creek floodplain from Kingsbury Drive to Wattle Avenue on 20 December 1986. The Eastern Extension Swamp contained an average depth of 10 cm of water. Waterbirds included:

- Moat System from Kingsbury Drive to the Outer Ring Road: 2 Hoary-headed Grebe, 2 Black Swan, 18 Dusky Moorhen (breeding), 5 Eastern Swamphen (breeding), 16 Eurasian Coot (breeding), 6 Grey Teal, 3 Hardhead, 1 Little Pied Cormorant, 2 Masked Lapwing (breeding), 2 Musk Duck, 34 Pacific Black Duck (breeding), 30 Silver Gull and 1 Australian Pelican.
- Core Area Wetlands: 2 Australasian Grebe (breeding), 3 Australian Spotted Crake (breeding), 1 Spotless Crake, 1 Yellow-billed Spoonbill, 1 Little Bittern, 1 Great Cormorant, 1 Little Pied Cormorant, 2 Black-fronted Dotterel (breeding), 9 Pacific Black Duck (breeding), 7 Dusky Moorhen (breeding) and 2 Eurasian Coot.
- Eastern Extension Wetlands: 1 Royal Spoonbill, 1 Great Egret, 2 Pacific Black Duck, 2 Chestnut Teal (breeding), 1 Swamp Harrier, 2 Buff-banded Rail (breeding), 2 White-faced Heron (breeding), 1 White-necked Heron and 16 Latham's Snipe.

As the water and habitat quality improved in the 1970s several waterbirds began breeding. These included the Eurasian Coot, Dusky Moorhen, White-faced Heron, Pacific Black Duck and Australian Wood Duck. Non-breeding visitors included the Yellow-billed Spoonbill, White-necked Heron, Hoary-headed Grebe, Grey Teal and Musk Duck. Small marshland passerines including the Clamorous Reed Warbler, Little Grassbird and Golden-headed Cisticola also established.

By the late 1970s, especially as the emergent herbfields of the Campus Wildlife Reserve Core Area wetlands and Eastern Extension Swamp established, the Australasian Grebe, Eastern Swamphen, Australian Spotted Crake and Chestnut Teal commenced breeding. After about 15 years (1984) aquatic ecosystems matured, productive mudflats developed and seed and invertebrate prey abundances increased. Rarer species such as the Little Egret, Royal Spoonbill, Nankeen Night Heron, Little Bittern, Spotless Crake and Baillon's Crake began appearing. Cover-dependent species such as the Buff-banded Rail commenced breeding in the grassy meadows of the Eastern Extension Swamp.

Thirty eight waterbird species have been recorded since 1986. An additional 7 species were seen between 1970 and 1978 (see birdlists from 1970–1978).

Eb 26^a: Dollarbird. One visited the River Red Gum grassy woodland (14.3) in the campus reserve for a few days in December 1989 (George Paras pers. comm.).

Eb 26^a: Tawny-crowned Honeyeater and other winter visiting honeyeaters. Eight species rare in urban Melbourne were present (excluding the resident New Holland and White-plumed Honeyeaters and Red Wattlebird) in ornamental flowering Spotted Gums, Bangalays and grevilleas of the Glenn College and Menzies College lawns on 10 July 1987. This does not meet sub-criteria *Ce* as it was artificial habitat. The birds included: 1 Crescent, 2 Brown-headed, 10 Fuscous, 3 Tawny-crowned, 1 Spiny-cheeked, 6 Yellow-faced and 50 White-naped Honeyeaters. The Spiny-cheeked and Tawny-crowned were more common in the 1970s. Occasional Yellow-tufted Honeyeaters were also recorded in the 1970s. The Tawny-crowned Honeyeater is predominantly a low shrub-dweller and frequently falls prey to cats, which are abundant on campus.

Ec 26^a: Spotless Crake. One amongst Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) near the Strathallan Creek inlet of the Main Lake in the evening of 16 December 1989. Several also heard calling in 25.7 at the north end of the Eastern Extension Swamp in November 1996 (George Paras pers. comm.). The Spotless Crake is a secretive and shy species that keeps to dense cover. Developing seasonal wetland dominated by Cumbungi and Tall Spike-sedge in the Yarra Lowland Alluvial Plains is becoming important for the conservation of the species in GM. More than half of the records for NEM during the 1986–1996 survey period were from this biophysical zone and habitat.

Ec 26^a: Azure Kingfisher, Black-eared Cuckoo and Red-capped Robin. A single kingfisher was seen in the Manna Gum plantation on the peninsula between the Main Lake and Small Lake on 21 March 1989. The robin and the

cuckoo were each observed as single birds in River Red Gum grassy woodland (14.3). The Black-eared Cuckoo was amongst a Tree Violet thicket near the Eastern Extension Twin Ponds on 20 December 1986. The Red-capped Robin was near the visitor centre in late winter 1995 (Richard Francis and Bruce Smith pers. comm.).

Ed **26^a: Australian Spotted Crake.** This species utilises the tall, dense cover provided by Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) in the Core Area and Eastern Extension wetlands (e.g. north end of the Eastern Extension Swamp in November 1996; George Paras pers. comm.). The crake was the first of the rarer cover-dependent waders recorded breeding in the campus reserve. A nest was located on a floating platform of Tall Spike-sedge in the Main Lake at the Strathallan Creek inlet on 20 December 1986. It contained three well-advanced young and was saucer-shaped and composed of green herbage.

Ed **26^a: Hardhead and Musk Duck of the moat system lakes.** Islands in the lakes provide a home for over a hundred waterfowl. Resident species include the Pacific Black Duck, Australian Wood Duck, Domestic Geese, Mallard, Dusky Moorhen, Eurasian Coot and Australasian Grebe. The Hoary-headed Grebe, Grey Teal and Musk Duck appear seasonally and the Hardhead and Black Swan visit occasionally. Waterfowl populations on the Main Lake and in the moat system have declined due to increased water turbidity from the Gresswell housing estate at Strathallan.

Ed **26^a: White-browed Woodswallow.** Two pair breeding in a mature River Red Gum (grassy woodland; 14.3) south of the old oval in the Eastern Extension on 20 December 1986. Observed several other years passing through in small flocks (e.g. 6 near Small Lake on 10 October 1994; George Paras pers. comm.).

Ee **26^a: Latham's Snipe.** Interviews conducted with a number of quail and snipe shooters revealed that the Strathallan Creek floodplain now contained in the La Trobe University Campus Wildlife Reserve has historically been (and remains) one of the most important non-coastal sites for Latham's Snipe near Melbourne. Small numbers are also found upstream in the Strathallan Habitat Link (site 25). Seasonal wetland in association with River Red Gum grassy woodland constitutes prime non-coastal feeding habitat for Latham's Snipe. Most locations within a 50 km radius of Melbourne which regularly supported snipe have been degraded in recent years, many being eliminated.

The significance of this site for snipe may increase as other key areas near Melbourne are eliminated or degraded. The number of visiting snipe each year varies from a few to 20 or 30 depending on conditions in northern Victoria and southern New South Wales. Sixteen birds were flushed from Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) in the Eastern Extension Swamp on 20 December 1986. During the 1982–83 drought, 70 birds were recorded along the middle Strathallan Creek floodplain (most at the Eastern Extension Swamp). Latham's Snipe shelter amongst the dense Austral Rush and Cumbungi during the day and move out to feed at dusk on the mudflats of the campus reserve lakes and ponds.

Ee **26^a: Buff-banded Rail and Swamp Harrier at Eastern Extension Swamp.** The rail was breeding amongst Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) on 20 December 1986. It was also recorded in Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) in the north-eastern corner of the Eastern Extension Swamp in November 1996 (George Paras pers. comm.). Possibly other rare species, including the Australasian Bittern and Brown Quail, occasionally visit the seasonal wetlands. The Eastern Extension is an excellent area for birds of prey (e.g. Black-shouldered Kite, Swamp Harrier, Little Eagle, Brown Goshawk and Australian Hobby). A single Swamp Harrier was observed over the Eastern Extension Swamp on 20 December 1986. It is very rare near Melbourne.

Ee **26^a: White-winged Triller and Rufous Songlark.** Both breeding in River Red Gum grassy woodland (14.3) in the Eastern Extension on 20 December 1986. Both were recorded on the 1970s birdlists. Seven other migratory insectivores including the Fan-tailed Cuckoo, Horsefield's Bronze-Cuckoo, Sacred Kingfisher, Tree Martin, White-browed Woodswallow, Dusky Woodswallow and Olive-backed Oriole were recorded breeding in grassy woodland at the Core Area/Eastern Extension on 20 December 1986.

Birdlists from 1970–1978 at La Trobe University. The following species from published lists compiled by Richard Zann and Philip Veerman have not been recorded over the last decade: Painted Button-quail, Peaceful Dove, Great Crested Grebe, Whiskered Tern, Red-capped Plover*, Glossy Ibis, Intermediate Egret, Australasian Bittern, Plumed Whistling-Duck, Collared Sparrowhawk*, Whistling Kite, Cockatiel, Australian King-Parrot*, Budgerigar, Leaden Flycatcher, Rose Robin, Bassian Thrush, White-throated Gerygone, Masked Woodswallow, Yellow-tufted

Honeyeater, Little Friarbird* and Chestnut-breasted Mannikin. Those shown by asterisk have been recently recorded in site 25. Most of the other species are either very rare or vagrant to the inner Melbourne area. Some, including the Glossy Ibis, are sporadic visitors during inland droughts (e.g. 1982).

A flock of a dozen Chestnut-breasted Mannikins appeared in 1977–78 on the peninsula of the Main Lake. They attempted to breed but were unsuccessful and disappeared, possibly due to unfavourable climate or predation. These would be derived from escaped aviary populations (see site 34).

Mammals

Ee **26^a: Platypus.** Sighting in the Main Lake in 1987, where it burrowed into the levee bank at the north end (George Paras pers. comm.). A skull dating from several years prior that was punctured with teeth marks was located near a disused fox den on 25 March 1996. The fox population has been controlled to a large degree. Platypus appear to occasionally disperse from the Yarra up Darebin and Strathallan creek.s. The reserve wetlands support suitable breeding and foraging habitat (Melody Serena pers. comm.) but water turbidity in the Main Lake from the Strathallan/Gresswell housing estate will need to be reduced.

26^a: Mammal re-introductions. Several species have been released in the campus reserve. The Brown Antechinus, Eastern Grey Kangaroo and Water Rat have established. Others including the Fat-tailed Dunnart and Southern Brown Bandicoot appear to have died out. Black Wallabies were introduced around 1970. By the mid-1970s they had increased from three to about 16 and were creating a heavy browsing impact on the establishing shrubs and saplings. They were subsequently removed. With the maturing of vegetation and addition of the Eastern Extension, the campus reserve could now possibly sustain a population of wallabies without a substantial impact on native vegetation.

The Water Rat population is supplemented by indigenous animals moving up the Strathallan Creek/Moat System from Darebin Creek. Feeding sites along rock batters of Strathallan Creek are occasionally observed (e.g. summer 1995 at the inlet to the Main Lake; Bruce Smith pers. comm.).

The Brown Antechinus and Swamp Rat were released around 1970. The Swamp Rat appeared to become established and was frequently observed over the following two decades. Runways were present in the Eastern Extension Swamp and near the Main Lake. None have been trapped and no evidence of their activity has been observed since 1990. Around this time the Brown Rat became entrenched and competition, along with predation from cats, possibly eliminated the Swamp Rat. They may survive in the Eastern Extension Swamp where extensive areas of habitat are present. The Brown Antechinus was occasionally observed in the River Red Gum woodland area (e.g. nest boxes; Graeme Ambrose pers. comm.) near Main Drive in the 1970s. In recent years, fox control and provision of ground logs for breeding habitat and protection from cats has enabled a population expansion.

The Sugar Glider was first recorded at the campus reserve in River Red Gum grassy woodland (14.3) in the south-eastern section (south of the old hospital tip) on 24 February 1994 (George Paras pers. comm.). It was observed in a River Red Gum, adjacent to a Black Wattle during a spotlight walk. This species had been previously seen at Gresswell Forest in 1987, which is the likely source of the campus reserve population, probably via Mont Park. A single animal was subsequently released in the campus reserve. Evidence of a fresh feeding scar on a Manna Gum was noted on the peninsula between the Main Lake and Small Lake on 2 January 1997. Revegetation of River Red Gum, Black Wattle and Blackwood in the Strathallan Habitat Link will facilitate movement between Gresswell and the campus reserve.

Reptiles

26^a: Campus Wildlife Reserve and La Trobe University. Eleven species are presumed indigenous (survey data and Grant Turner and Mark Hutchinson pers. comm.). The provision of logs and rocks in the campus reserve has facilitated population expansions of several of the lizards and the wetlands have provided habitat for the snakes. Species include:

- **Common Long-necked Tortoise:** substantial breeding population, particularly in the Eastern Extension Ponds
- **Common Blue-tongued Lizard:** with the provision of logs and rocks this species has become common
- **Blotched Blue-tongued Lizard:** seen in recent years only and uncommon; the origin is uncertain but possibly derived from the remnant population at Gresswell
- **Delicate Skink:** uncommon in grassland areas, particularly near the old hospital tip
- **Garden Skink:** common and widespread

- **Weasel Skink:** surrounds of campus buildings and under debris in the old Mont Park tip on the eastern side of the reserve; the tip has gone (revegetating grassy woodland) and the skink now occupies grassland flanking seasonal wetland at the Eastern Extension Swamp; expanding range with provision of logs and rocks
- **Tussock Skink:** uncommon in grassland areas
- **Eastern Three-lined Skink:** one recorded in grassland near the old hospital tip
- **Little Whip Snake:** extension along Strathallan Creek from the Quaternary volcanics near the Darebin Creek; seen amongst rock batters near the creek in the campus reserve
- **Tiger Snake:** uncommon at wetlands, particularly the Eastern Extension Swamp
- **Eastern Brown Snake:** rare but occasionally seen near the university moat

26^a: Reptile re-introductions at the Campus Wildlife Reserve. Species known to be introduced which have established include the Southern Water Skink (Strathallan Creek in the Eastern Extension), Cunningham's Skink (rock batters of Strathallan Creek), White's Skink (Eastern Extension Swamp) and Bougainville's Skink (under woodland debris). A young Lowland Copperhead was recently released at the Eastern Extension Swamp.

Butterflies

26^a: La Trobe University. 20 species (Braby 1989). The Creeping Mistletoe, which is widespread on the large River Red Gums throughout the campus, supports the Dark Purple Azure butterfly and the larval attendant ant, a Crematogaster species. The ants and butterfly larvae live under strips of loose bark on the tree trunks near the mistletoe. An extensive population is present, which indicates the importance of the large stand of mature River Red Gums at La Trobe.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Partially intact habitat links upstream along Strathallan Creek to the Gresswell Forest site and downstream to the Dougharty to Plenty Road site of the Darebin Creek. Links for birds to the Bundoora Park and Simpson Barracks sites. By the mid-1990s, as grassy woodlands planted in the late 1970s and early 1980s matured, new forest birds began visiting the site. These include the Yellow-tailed Black-Cockatoo, Shining Bronze-Cuckoo, Rufous Whistler and White-eared Honeyeater.

Restricted faunal connectivity from habitat loss and fragmentation has resulted from past land clearing for farming and recent clearing for urban development.

Regional Hydrological Strategy

Water turbidity of the campus wetlands from upstream sources. This has been a long-term problem. Levels had declined by the 1990s, with the establishment of aquatic vegetation in Strathallan Creek and at the inlet to the Main Lake. This filters out the sediment load of incoming water. Earthworks associated with the Gresswell housing estate at Strathallan have greatly increased water turbidity in the Main Lake. This has led to an appreciable decline in waterfowl populations and would limit the colonisation potential of Platypus.

This was one of the main concerns raised when the housing development was proposed. As a result, the Urban Land Authority constructed stormwater retarding ponds north of Wattle Avenue to intercept incoming water from the housing estate. Until aquatic vegetation can fully establish, these will not function effectively. The quality of stormwater input may improve when the housing development is finished but renewed development along Gresswell Road will continue to be a turbidity point source.

Strathallan Creek hydrological study. This is needed to address the increasing problem. An effective interceptor and filtration system is required for runoff from the housing development. Filtration of stormwater from Mont Park before it reaches the Eastern Extension Swamp/Strathallan Creek would be desirable. Increased flow from this source may raise the top water level and kill the old River Red Gums surrounding the swamp. Turbidity and water contamination in the event of future housing subdivision at Mont Park will need to be managed.

Over Twenty Years of Conservation Management for Wetlands

Two decades of wetland rehabilitation and revegetation. The wetlands under management in the campus reserve have been extensively rehabilitated and revegetated. Until recent upstream housing development, water quality in the system had steadily improved and had been a major factor in attracting waterbirds and sustaining resident species.

Establishment of the Campus Wildlife Reserve Core Area. About 50% of the original Strathallan Creek floodplain is now contained in the Campus Wildlife Reserve and Strathallan Habitat Link (site 25). The university began managing the 9 ha Core Area in 1967. At the time, Strathallan Creek was a degraded channel running through cleared, alien pasture-dominated cow paddocks. The lakes in the Core Area were created around 1969 during an earthmoving machinery open day. Prior to this some non-indigenous eucalypt plantations had been established and some screen plantings were put around the lakes after they were formed. For the next few years the garden staff at La Trobe maintained the Core Area.

Core Area wetland revegetation in the mid-1970s—Main Lake and Small Lake. The emergent herbfield (25.7) at the north-west corner of the Main Lake near the Strathallan Creek outflow and the Small Lake at the south-west corner of the Main Lake were established from only a small amount of propagule. In summer 1974/75, Tall Spike-sedge, Mud Dock and Water Plantain were collected from the drainage line swamp between Chelsworth Park and Wilson Reserve. Seed of Swamp Paperbark was obtained from behind Ivanhoe Golf Course near Bailey Billabong. Common Spike-sedge, Water-ribbons, Floating Pondweed and Upright Milfoil were secured from Banyule Swamp. During the late 1970s and 1980s other species including Common Nardoo, Short-fruit Nardoo, Floating Club-sedge and Giant Rush from near Bolin Billabong at Bulleen and other local sources were propagated and planted.

Main Lake. Tall Spike-sedge was planted in the black mud below the outlet of Strathallan Creek. This area formed a sump for silt, oil, detergent and other contaminated runoff including heavy metals from upstream sources. The spike-sedge quickly established in the open water and assisted in settling the suspended matter. The old canes provide nesting platforms for a range of waterbirds including the Australian Spotted Crake and Dusky Moorhen and foraging habitat for others including the Spotless Crake. Swamp Paperbark seedlings were planted on the adjacent shoreline at a working bee in winter 1975. A thicket of paperbark and suckers forming a band several metres wide now fringes this section of the lake. This provides a screen for waterbirds in the spike-sedge beds.

Giant Rush is well-established in this area and also supports nesting waterfowl and small marshland passerines (e.g. Little Grassbird). Several natural successions of native species replacing alien species have occurred at the Main Lake. The most dramatic has been that of Cumbungi (*Typha orientalis*) over Great Reedmace. The latter which has been forced to grow on the shorelines by the former is extensively grazed by kangaroos and swamphens. Mudflat semi-aquatics including Australian Lilaepsis, Swamp Crassula, Waterwort, Slender Knotweed and Upright Milfoil occupy most of the wetland fringes. These have substantially replaced the alien Jointed Rush, Drain Flat-sedge and Water Couch sward.

Small Lake. Common Spike-sedge, Floating Club-sedge, Water-ribbons, Common Reed, Floating Pondweed and Upright Milfoil were planted. These quickly established and along with Tall Spike-sedge and Cumbungi, provided habitat for the Little Bittern and Baillon's Crake by the mid to late 1980s. The Small Lake is the most floristically intact (native species-rich and alien species-poor) of the campus reserve wetlands.

Eastern Extension wetland revegetation in the late 1970s. The Eastern Extension, comprising about 19 ha was excised from the hospitals and added to the reserves in 1976. The wetlands consist of the Eastern Extension Swamp (3 ha), the Strathallan Creek and a half dozen ponds. Strathallan Creek passes to the west of a broad floodplain, part of which had been filled many years ago for sports fields (now under natural regeneration).

Revegetation of the ponds began in 1977 and the wetland habitat was well-established by the early 1980s. Propagule for plants at the ponds was collected from several sources, notably the Yarra River (e.g. Stream Club-sedge) and Plenty Gorge (e.g. Golden Spray). Extensive weed control of the Strathallan Creek floodplain is being undertaken. Woody weeds including Desert Ash and Blackberry have been targeted. Control of herbaceous weeds is being upgraded. The creek has been reformed and replanted after it enters from Wattle Avenue .

Eastern Extension Swamp. The band of Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) fringing the swamp provides a balance to the open water and emergent herbfield habitats fringing the permanent wetlands within the Core Area. This is a rare freshwater habitat in NEM and one of the more important for rare cover-dependent waterbirds (e.g. Latham's Snipe, Buff-banded Rail and possibly the Australasian Bittern). The north-eastern section of the swamp is fed by stormwater from Mont Park and contains a deeper (0.7 m at high water) channel supporting Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7). The levee-bank around the north end of the Main Lake in the Core Area has enabled more extensive flooding of the Eastern Extension Swamp. As a result, the central section of the swamp holds water most of the year and the rush fringes are inundated in winter–spring.

Eastern Extension Ponds. Two ponds (one about 0.5 m and the other about 1.5 m deep) were created downstream of Wattle Avenue near a track between the swamp and the creek in summer 1976. These were planted with low emergent vegetation including Water Plantain, Common Spike-sedge, Swamp Crassula, River Mint, Running Marsh-flower (from Yan Yean Reservoir) and Upright Milfoil. The fringes were planted with riparian species collected from the Plenty Gorge and Yarra River. These included Spiny-headed Mat-rush, Tree Everlasting, Hop Goodenia, Silver Wattle, Blackwood, River Bottlebrush, Swamp Gum, Woolly Tea-tree, Swamp Paperbark and Prickly Currant-bush. Additional ponds have been created in recent years. Several of the ponds have been stocked with the potentially threatened freshwater fish, the Dwarf Galaxias.

Further downstream near the Core Area, twin filtration ponds were created through which the creek was diverted. The banks were planted with Golden Spray, the fringes with Swamp Crassula and the central area with Stream Club-sedge and Water Plantain.

Wetland rehabilitation—a generation of planning and development. It is 28 years since the first wetland earthworks and 23 years since the commencement of the indigenous revegetation program in the reserve. This time-scale has enabled the development of a functional wetland system. Habitat viability in the campus reserve has been dependent on the interaction of flora and fauna. For example, wetland regeneration has been benefited by the grazing activities of species, including the Eastern Swampheh and Eastern Grey Kangaroo, which have selectively grazed alien grasses including Water Couch, Kikuyu, Toowoomba Canary-grass, Indian Rat-tail Grass and Buffalo Grass. This has promoted the establishment of sedges and other semi-aquatic plants and opened up areas for low-growing or ephemeral natives to establish.

Developmental stage of the wildlife reserves. The university appointed one of the gardeners (Rod Foster) in 1973 to work part-time in the Core Area. He was appointed full-time ranger in 1974 and continued in that role until his untimely death in 1985. During this period, students including Geoff Carr (now senior consultant botanist with Ecology Australia) and support staff from the university became involved with the restoration program. Several thousand indigenous plants were grown and planted in the Campus Wildlife Reserves from the mid-1970s to mid-1980s. Many of these were wetland and riparian species. A second full-time ranger was appointed in 1979. A management plan was later devised for the revegetation works, particularly the wetlands (Carr 1983).

Consolidation stage of management programs and educational facilities at the reserves. Over the last decade, George Paras has been head ranger of the wildlife reserves. This period has seen the fruition of the most successful long-term conservation and habitat enhancement project in NEM. The wetland development program has been consolidated and restoration of the River Red Gum woodland has begun. The Campus Wildlife Reserves are of incalculable value to education. Thousands of people have visited on tours and open days or been actively involved with voluntary working bees. Zoology undergraduate field practical studies are undertaken each year and numerous post-graduate students and staff members have conducted research in the reserves. The Friends of the Wildlife Reserves, which contains over 30 active members, has provided a focus for community involvement.

Planning Recommendations

Green web park. The Campus Wildlife Reserves when joined to Gresswell Forest through the Strathallan Habitat Link should be resourced and serviced as a major Green Web Park.

YLAP B PLENTY RIVER LOWER REACHES

This management unit consists of two sites of regional faunal significance (sites 27 and 28) and surrounding land that forms habitat links.

- Map Reference:** 7922 326205 to 7922 335234 (Plenty River); 7922 318228 (mid-point of Simpson Barracks).
Location/Size: Plenty River from the Heidelberg Golf Club, 500 m upstream of the Yarra River to 1 km upstream of Lower Plenty Road at Yallambie; Simpson Barracks, Watsonia. Approximately 470 ha.
Municipality: City of Banyule.

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands. It contains the lower reaches of the Plenty River above the confluence with the Yarra River. The hills are low and contain colluvial slopes and alluvial valleys.

Landforms

Foothill: hill-crests, hill-slopes and gullies. Alluvial plain: plain-slopes, valleys, stream and floodplains, creeks and dams. Elevation is 30–80 m.

Hydrology

The Plenty River is perennial and contains deep, reed-lined pools (up to 4 m depth) along a meandering floodplain. Yallambie Creek was formerly ephemeral and in summer would have contained shallow, static pools, exposed rocky reefs and dry cobble and gravel riffles with sandy banks. It rises in the residential area north of Yallambie Road, upstream of Simpson Barracks. It is fed by runoff from the residential area and roads and is mildly polluted. Severe channelisation and bank erosion is present along the creek south of Yallambie Road. Banyule Creek rises within Simpson Barracks. Several shallow dams occur on the barracks. The creek is fed by urban runoff downstream of the barracks.

Rainfall: 660 mm.

Site 27 Plenty River Flats

Map Reference:	7922 326205 to 7922 335234 (Plenty River). One minute lat/long grids include 37°43' x 145°06' and 37°44' x 145°06'.
Location/Size:	Approximately 350 ha.
Municipality:	City of Banyule.
Land Tenure/Use:	Public: west side of the Plenty River below Martins Lane in Yarra Valley Park (Melbourne Parks & Waterways). Private: remainder of site including commercial broadcasting station transmission land and sections of the Rosanna and Heidelberg Golf Clubs.
Landforms:	Foothill and alluvial plain (see YLAP B). Elevation is 20–60 m.

Natural Heritage Values

Landscape. The River Red Gum (alluvial plains) grassy woodland of Stawell Road and Cleveland Avenue to the east of the Plenty River and at the end of Martins Lane to the west of the river is an extension of the Westerfolds Park landscape. This is the most extensive representative of few remaining areas of this landscape along the Yarra River and in the eastern suburbs of Melbourne.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Manna Gum gully woodland (10.1); Long-leaf Box–Manna Gum escarpment woodland (13.1); River Red Gum (alluvial plain) grassy woodland (14.3); River Red Gum (riverbank) floodplain riparian woodland (16.2; lower reaches of Plenty River); Manna Gum (riverbank) floodplain riparian woodland (16.4)

Remnant, degraded or establishing stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark grassy woodland (14.6); River Red Gum (plains) drainage line woodland (30.1); Manna Gum (terrace) floodplain riparian woodland (16.5); Common Reed–Cumbungi–Tall Spike–sedge seasonal wetland (25.7)

Critical assemblages or populations: Strategic Habitat Link

Notable features: mature River Red Gums at Seymour Road and Cleveland Avenue/Stawell Road.

FAUNAL SIGNIFICANCE: Site 27 Plenty River Flats

Assessment: Regional—Category 1 (B, C, D, E)

Reference grids for the significance keys include:

27^a: 37°43' x 145°06'; Plenty River Yallambie/Montmorency

27^b: 37°44' x 145°06'; Plenty River flats—Viewbank/Lower Plenty

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 27^a: Swift Parrot

c. Rare fauna

Regional. 27^a: Eastern Broad-nosed Bat

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 27^b: 7 species including the Sacred Kingfisher, Rufous Songlark, White-winged Triller, White-browed Woodswallow and Olive-backed Oriole in River Red Gums at Stawell Road Lower Plenty on 2 January 1991

g. Breeding parrots

Regional. 27^b: 6 species (Musk Lorikeet, Rainbow Lorikeet, Sulphur-crested Cockatoo, Galah, Eastern Rosella and Red-rumped Parrot) in River Red Gums at Stawell Road Lower Plenty on 2 January 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 27^a: 92 species

b. Native birds

Regional. 27^b: over 80 species. **27^a:** 73 species

c. Native mammals

Regional. 27^a: 11 species (7 species of bats)

d. Herpetofauna

Local. 27^a: 8 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 27^b: 10 species. **27^a:** 7 species

b. Regionally endangered fauna (R1 species)

Regional. 27^a: 3 species. **Birds:** White-fronted Honeyeater, Noisy Friarbird. **Mammals:** Eastern Broad-nosed Bat

c. Regionally vulnerable fauna (R2 species)

Regional. 27^b: 2 species. **Birds:** Hooded Robin. **Mammals:** Southern Freetail Bat

d. Regionally rare fauna (R3 species)

Regional. 27^b: 5 species. **Birds:** Australian Spotted Crake, Darter, Collared Sparrowhawk, Little Corella, White-browed Woodswallow

Regional. 27^a: 2 species. **Mammals:** Grey-headed Flying-fox. **Reptiles:** Marbled Gecko

e. Regionally depleted fauna (R4 species)

Regional. 27^b: 3 species. **Birds:** Buff-banded Rail, White-winged Triller, Rufous Songlark

Regional. 27^a: 2 species. **Birds:** Peregrine Falcon, Leaden Flycatcher

f. Regionally restricted fauna (R5 species)

Regional. 27^a: 10 species. **Birds:** Nankeen Night Heron, Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, Rose Robin. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink

Regional. 27^b: 9 species. **Birds:** Pied Cormorant, Great Egret, Nankeen Night Heron, Australian Hobby, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet. **Reptiles:** Common Long-necked Tortoise, Tussock Skink

Outlook

Faunal significance has been consolidated in Regional Category 1 by habitat enhancement works in Yarra Valley Park.

FAUNA

Rare or Threatened Fauna

- Bb* **27^a: Swift Parrot.** Observed in remnant Long-leaf Box–Manna Gum escarpment woodland (13.1) above the Plenty River at Tarcoola Drive Yallambie in 1986 (Ian Temby pers. comm.).
- Bc* **27^a: Eastern Broad-nosed Bat.** One recorded in a nest box in remnant Long-leaf Box–Manna Gum escarpment woodland (13.1) above the Plenty River at Tarcoola Drive Yallambie on 13 January 1989 (Ian Temby pers. comm.).

Other Significant Fauna

Birds

- Cg* **27^b: Breeding parrots.** The extensive stand of mature River Red Gum grassy woodland (14.3) at Seymour Road, Viewbank and the continuation on the east side of the Plenty River at Stawell Road/Cleveland Avenue, Lower Plenty is important for parrots. The Musk Lorikeet, Rainbow Lorikeet, Sulphur-crested Cockatoo, Galah, Eastern Rosella and Red-rumped Parrot were nesting in River Red Gum hollows at Stawell Road on 2 January 1991.
- Eb* **27^a: White-fronted Honeyeater.** A single bird feeding on nectar from garden shrubs at Longs Road Montmorency from October 1991 and June 1992 (John Alderson pers. comm.). This was the only sighting in GM during the 1986–1996 survey period. Prior to this, birds had been only seen as drought vagrants at the You Yangs (1967) and Point Addis (1982). This honeyeater is normally associated with mallee shrublands of north-western Victoria.
- Eb* **27^a: Noisy Friarbird.** This rare spring–summer visitor was recorded at Tarcoola Drive, Yallambie on 25 October 1985 (Ian Temby pers. comm; see below). Most recent records of the friarbird in GM have been associated with flowering Yellow Box, River Red Gum or Manna Gum (along streams) to the north of Melbourne.
- Ec* **27^b: Hooded Robin.** One in a thicket of Tree Violet and Sweet Bursaria under River Red Gum grassy woodland (14.3) at Seymour Road Viewbank on 3 April 1992. This rare species breeds in shrublands associated with box–stringybark woodland in the lowland hills. In autumn–winter they disperse into open habitats on the plains.
- Ed* **27^b: Darter.** Lower section of the Plenty River at Rosanna Golf Club in River Red Gum floodplain riparian woodland (16.2) on 25 April 1990 (Richard Loyn pers. comm.). Populations of this species along with the Nankeen Night Heron and Collared Sparrowhawk have expanded with habitat enhancement works in Yarra Valley Park.
- Ed* **27^b: Collared Sparrowhawk.** One flying through Manna Gum floodplain riparian woodland (16.4) along the Plenty River north of Banyule Road on 3 April 1992. This species (along with several other birds of prey such as the Australian Hobby) has become more common in the Lower Yarra since the early 1990s (see Black Falcon in site 34).
- Ed* **27^b: White-browed Woodswallow.** Pair breeding in River Red Gum (plains) drainage line woodland (30.1) along a drainage line at Stawell Road Lower Plenty on 2 January 1991.
- Ee* **27^b: Buff-banded Rail.** Dead bird near Seymour Road in winter 1992 (Glen Jameson pers. comm.).
- Ee* **27^b: White-winged Triller and Rufous Songlark.** Both breeding in River Red Gum grassy woodland (14.3) at Stawell Road Lower Plenty on 2 January 1991.
- 27^a: Birdlist for Tarcoola Drive at Yallambie.** Sixty-nine native species were recorded by Ian Temby (of the Department of Natural Resources and Environment) from 1985 to 1988. The area is above the west escarpment of the Plenty River, about 500 m upstream of the Main Road bridge. Vegetation consists of remnant Long-leaf Box–Manna Gum escarpment woodland (13.1), Manna Gum (riverbank) floodplain riparian woodland (16.4) and ornamental native garden shrubs.

Significant species include the Nankeen Night Heron, Australian Hobby, Peregrine Falcon, Barn Owl, Rainbow Lorikeet, Long-billed Corella, Swift Parrot, Rose Robin, Leaden Flycatcher and Noisy Friarbird.

Most of the species are dependent on the habitat link along the Plenty River. This section is a wintering area for foothill and mountain species (e.g. Yellow-tailed Black-Cockatoo, Gang-gang Cockatoo and Rose Robin) moving between the ranges at Kinglake and Mt Disappointment and the Yarra River. The Gang-gang Cockatoo feeds extensively on ripened Hawthorn fruits and the Yellow-tailed Black-Cockatoo feeds on Monterey Pine nuts. The site also forms a habitat link between the Yarra and the Plenty Gorge and constitutes the nearest regular approach to Melbourne for some

forest species (e.g. Leaden Flycatcher, Rufous Whistler and Pied Currawong). The site may form a link for the endangered Regent Honeyeater to surrounding feeding grounds at the Plenty Gorge, La Trobe University–Mont Park and the Yarra River between Eltham South and Warrandyte.

27^b: Birdlist for Viewbank. Seventy-four native species were recorded by Richard Loyn (of the Department of Natural Resources and Environment) from 1988-92. The area is centred in Yarra Valley Park on the west side of the Plenty River from Rosanna Golf Club to Martins Lane. Vegetation consists of Long-leaf Box–Manna Gum escarpment woodland (13.1), River Red Gum (alluvial plain) grassy woodland (14.3), River Red Gum (riverbank) floodplain riparian woodland (16.2; downstream section of Rosanna Golf Club) and Manna Gum (riverbank) floodplain riparian woodland (16.4). Several dams contain small stands of Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7).

Significant species include the Australian Spotted Crake, Pied Cormorant, Darter, Great Egret, Nankeen Night Heron, Australian Hobby, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet and Little Corella.

Mammals

Ec **27^b: Southern Freetail Bat.** A male was trapped in River Red Gum grassy woodland (14.3) along Seymour Road at the east end of Martins Lane on 3 April 1992. The freetail bat is rare in the metropolitan area as it inhabits extensive stands of mature trees (containing nest hollows). Most captures in GM have been associated with River Red Gum near streams or waterbodies in rural/bushland sections of the volcanic and alluvial plains.

Ed **27^a: Grey-headed Flying-fox.** Recorded on one occasion between 1986 and 1988 at Tarcoola Drive, Yallambie (Ian Temby pers. comm).

27^a: Bats utilising an artificial nest box at Tarcoola Drive, Yallambie. Six species have been recorded (Ian Temby pers. comm.). The Eastern Broad-nosed Bat (see Bc) was present along with 8 Gould's Wattled Bats and 1 White-striped Freetail Bat on 13 January 1989. The Chocolate Wattled Bat, Little Forest Bat and Large Forest Bat have also been recorded. The nest box is a simple rectangular construction along the lines of that drawn in the Yarra Book. It has a narrow horizontal 'letter box' entrance and is divided lengthwise internally by a partition containing chicken wire. There is an access hole to the rear.

27^a: Platypus. They were resident in the lower Plenty River until the late 1960s, before the onset of intensive residential development upstream (Ian Temby pers. comm.). They were frequently observed moving along the river in numbers at certain times of the year (e.g. 17 animals in an evening in the late 1960s, Ian Temby pers. comm.). The species has not been seen in this stretch of the river since 1983 but still breeds upstream in Plenty Gorge and in the Yarra River upstream of Diamond Creek. The water has become polluted, stream banks have become degraded and native riparian vegetation has been severely depleted. No native fish species were located upstream at Montmorency Park (site 45) during a recent electrofishing survey (McKenzie & O'Connor 1989).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link (streamway) between the Banyule Flats site and Bonds Road/Westerfolds site along the Yarra and the Yallambie to Greensborough site along the Plenty River. Ineffective overland link to the Simpson Barracks site.</p>	
<p>Loss of River Red Gum grassy woodland habitat to farming and residential encroachment. An unbroken band of River Red Gum grassy woodland averaging 10 km width formerly extended over 70 km across the plains from Donnybrook to Cranbourne. About 5% of this 70 000 ha survives more or less intact on the Plenty Volcanic Plains in a belt between Yan Yean and Woodstock (site 15). The remaining volcanic plains grassy woodland was cleared or thinned for farmland or overtaken by urban growth between Epping and South Morang. The alluvial plains grassy woodland to the south was totally enveloped by urban development. About a dozen small and fragmented stands remain. These are being subjected to increasing levels of disturbance and degradation. One of the notable surviving stands flanks the lower Plenty River at Viewbank/Lower Plenty.</p> <p>Habitat link severance and degradation. Habitat links except the river frontage have been cut. The Plenty River passes through suburbs between Plenty Gorge and the Yarra River and its utility as a faunal corridor has been 'bottlenecked'. Little of the native shrubland and woodland vegetation flanking the river valley remains. The floodplain riparian woodland along the river valley is degraded.</p> <p>Advanced dieback of River Red Gums and Blakely's Red Gums. Mature River Red Gums are scattered through the site including remnant trees in new residential subdivisions. These trees are undergoing the most severe and widespread leaf defoliation and branch and canopy dieback seen in GM. Trees in remnant stands near the river adjacent to commercial and residential development along Lower Plenty Road have been subjected to long-term dieback and many recent tree deaths have occurred.</p>	<p>Establishment of a broader strip of non-riparian vegetation flanking the Plenty River. Given the loss of nearby habitat (e.g. Timber Ridge housing estate) replanting of a broader non-riparian strip of woodland and shrubland is viewed as essential to improve the effectiveness of faunal dispersal and the viability of resident fauna in the river corridor.</p> <p>Role of the lower Plenty River as a Green Web. The public open space of the Plenty River between the Plenty Gorge and the Yarra River should be considered a Green Web as it links several important sites of biological significance.</p>

Regional Hydrological Strategy

Environmental weeds of the Plenty River

floodplain and escarpment. There are dozens of environmental weeds present. Threatening woody or dicot species include Hawthorn, White Crack Willow, African Box-thorn, Blackberry, Cherry-plum, Montpellier Broom, Gorse, Blue Periwinkle, Japanese Honeysuckle, Cleavers and English Ivy. Threatening herbaceous or monocot species include Bridal Creeper, Three-cornered Garlic, Wandering Jew, Cocksfoot, Panic Veldt Grass and Toowoomba Canary-grass.

Rehabilitation and land protection of the Plenty

River streamway. Priority works should include the control of environmental weeds and replanting of indigenous floodplain and escarpment vegetation. These works need to be coordinated by the City of Banyule and community groups such as the Friends of the Lower Plenty River. A plan for indigenous garden and streetscapes should be developed for land fronting the Plenty River.

Site 28 Simpson Barracks

- Map Reference:** 7922 318228 (mid-point of Simpson Barracks). One minute lat/long grids include 37°43' x 145°04' to 145°05'.
- Location/Size:** Situated between Greensborough Road, Yallambie Road and Lower Plenty Road at Watsonia, 18 km north-east of the Melbourne CBD. Approximately 120 ha.
- Municipality:** City of Banyule.
- Land Tenure/Use:** Public: Simpson Barracks (Commonwealth Department of Administrative Services, under the control of the Commander 3rd Military District, Australian Army). CSIRO is the principal source of scientific and technical advice for Army land management. Adjacent cleared sections of the barracks to the south-east of the site were leased for horse agistment (e.g. Lower Plenty Pony Club) at the time of the fauna survey of the early 1990s. This area (about 50 ha) has since undergone housing development by the Defence Housing Authority.
- Landforms:** Foothill and alluvial plain (see YLAP B). Elevation is 60–80 m.

Natural Heritage Values

Landscape. The River Red Gum (alluvial plain) grassy woodland at Simpson Barracks provides an extensive and representative stand of the original vegetation of the lowland alluvial plains. Simpson Barracks, Gresswell Forest (site 25) and Thomsons in Yarra Valley Park (site 35) contain the only intact (overstorey and understorey) remnants of the landscape now underlying Melbourne's eastern suburbs.

Scientific and Educational Values

Rehabilitation and management. Rehabilitation works, particularly weed removal, have been undertaken by the Army. Sections of grassland are revegetation and research areas managed in conjunction with staff from the La Trobe University Wildlife Reserves.

Public interpretation. The woodland landscape has high natural history significance. The Army is taking action to enhance the natural environment and has expressed a wish that the area achieve a more positive public profile (Simpson Barracks Land Management Plan). The Army proposes that the woodland and grassland areas be available for research and interpretation.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference stands: nil

Relatively intact and extensive stands: River Red Gum (alluvial plain) grassy woodland (14.3)

Partially intact or small stands: Swamp Gum gully woodland (10.3)

Remnant, degraded or establishing stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); River Red Gum (drainage line) grassy woodland (11.4; upper Banyule Creek); Common Reed–Cumbungi–Tall Spike–sedge seasonal wetland (25.7)

Notable features: the most intact stand of woodland in the City of Banyule and one of the most intact and representative (shrub/field layers) stands of mature River Red Gum (alluvial plain) grassy woodland remaining in GM. It supports species (e.g. Narrow Rock Fern, Hill Sedge, Blue Grass-lily, Blown Grass/*Agrostis aemula* var. *aemula*, Five-awned Spear-grass, Mat Grass, Small-flower Mat-rush, Sweet Hound's-tongue, Blue Pincushion, Matted Bush-pea, Broad Stinkweed and Curved Rice-flower) which are very rare or extinct elsewhere in the City of Banyule. This habitat has been fragmented and degraded throughout its range in GM. Scattered Blakely's Red Gums at Rentons Ridge. The rare *Eucalyptus studleyensis* (River Red Gum X Swamp Gum) hybrid occurs east of Yallambie Creek.

FAUNAL SIGNIFICANCE: Site 28 Simpson Barracks

Assessment: Regional—Category 2 (B, C, D, E, F)

Reference grids for the significance keys include:

28^a: 37°43' x 145°04'; Simpson Barracks–Greensborough Road/Banyule Creek

28^b: 37°43' x 145°05'; Simpson Barracks–Rentons Ridge/Yallambie Creek

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 28^b: Swift Parrot (14 September 1992)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

g. Breeding parrots

Regional. 28^a: 5 species including the Musk Lorikeet, Little Lorikeet and Red-rumped Parrot in the Greensborough Road woodlands on 23 November 1992

k. Frogs

Local. 28^b: 5 species in the drainage line ponds between Rentons Ridge and upper Yallambie Creek on 6 October 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 28^b: over 70 species

b. Native birds

Regional. 28^b: over 50 species

c. Native mammals

Regional. 28^b: 5 species

d. Herpetofauna

Regional. 28^b: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 28^b: 1 species

e. Regionally depleted fauna (R4 species)

Local. 28^b: Swift Parrot

f. Regionally restricted fauna (R5 species)

Local. 28^b: 7 species. **Birds**: Cattle Egret, Australian Hobby, Rainbow Lorikeet, Long-billed Corella. **Reptiles**: Common Long-necked Tortoise, Delicate Skink, Tussock Skink

Local. 28^a: 1 species. **Birds**: Little Lorikeet

g. Nesting birds of prey/parrots

Regional. 28^a: Little Lorikeet (River Red Gum hollow near Greensborough Road on 23 November 1992)

F. POPULATION DENSITY: Viability and Abundance—point census

o. Regionally restricted fauna (R5 species)

Regional. 28^b: 10 Delicate Skinks in a 30 minute herpetofauna search at Rentons Ridge on 6 October 1990

Outlook

The faunal significance may decline from Regional Category 2 to Category 3 over the next few years due to habitat link severance and loss in vigour of the River Red Gum woodlands caused by eucalyptus dieback. The poor significant species representativeness (Category E) is attributable to fragmentation.

FAUNA

Rare or Threatened Fauna

Bb 28^b: Swift Parrot. Two in River Red Gum grassy woodland (14.3) at Rentons Ridge on 14 September 1992. They were feeding on psyllids on Yellow Box (predominantly *Glycopsis*) and River Red Gums (predominantly *Hyalaspina*).

Other Significant Fauna

Birds

Cg 28^{ab}: River Red Gums—important for parrots. The River Red Gum grassy woodland (14.3) at Simpson Barracks is important for nesting parrots. The Red-rumped Parrot and Musk and Little Lorikeets were observed in the Greensborough Road woodlands and the Eastern Rosella was observed at Rentons Ridge on 23 November 1992.

28^b: Declining populations of forest insectivores. Remnant populations of foliage insectivores are present (e.g. Fan-tailed Cuckoo, Rufous Whistler and Spotted Pardalote). Expanding populations of Noisy Miners appear to be driving these away. Species such as the Grey Currawong, which spend a lot of time on the ground, seldom persist in fragmented urban bushland because of competition from ravens and magpies. There was a noticeable decline in numbers and diversity of the canopy insectivores (and an overall increase in canopy foliage loss and tree dieback) between the spring visits of 1990 and 1992. The Spotted Pardalote was breeding in the banks of Yallambie Creek on 6 October 1990. When revisited on 23 November 1992 the entire section of bank was found to have slumped into the creek and the pardalotes were absent.

The Striated Pardalote nests in River Red Gum hollows. A number of the old trees have recently died (eucalyptus dieback). To compensate for this, the army has recently put up pardalote nest-boxes (Wayne Ellery pers. comm.). These are rectangular boxes about 40 cm by 20 cm, lying on their sides, with about 10 cm of 3 cm-diameter plastic drain pipe extending as an entrance from the front.

Reptiles

28^b: Rentons Ridge/upper Yallambie Creek. Seven species were recorded. The Tussock Skink, which is characteristic of the basalt plains grasslands to the west, is approaching the eastern range limit in NEM in this site. It was recorded under the River Red Gum grassy woodland (14.3) at Rentons Ridge. Both species of blue-tongued lizards were recorded. The Common Blue-tongued Lizard occurs mainly on the volcanic and alluvial plains. A road-kill Blotched Blue-tongued Lizard was found on Yallambie Road. This species is close to local extinction. It is characteristic of foothill herb-rich forests to the north-east and occurs on the plains only near the Plenty River. Occasional Eastern Brown Snakes are observed (Wayne Ellery pers. comm.). This species is also close to local extinction. The Delicate Skink is common in Kangaroo Grass and Weeping Grass areas. The Eastern Three-lined Skink was located under rock debris near the old tip.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. New development along Lower Plenty Road has severed the last remaining effective habitat link. Fragmented links for birds occur to the east across open space and residential areas to the Plenty River Flats and to the south along Banyule Creek to the Banyule Flats on the Yarra River. Some bird movement occurs to the west across the residential area of Macleod to La Trobe University and Gresswell Forest. The Plenty River Flats form a significant green web link between the Yarra River and Plenty Gorge.</p>	
<p>Encroachment of residential development—habitat fragmentation. Residential development surrounding Simpson Barracks has fragmented the River Red Gum woodland from stands at La Trobe University–Mont Park and on the Plenty–Yarra River flats. Development on the horse agistment area will cause further fragmentation of the remaining stand of River Red Gum woodland.</p> <p>Loss of habitat links for foliage birds. Severance of habitat links by development has led to the loss of native avifauna species, particularly forest-dependent insectivores. Several of the surviving species face local extinction. Increased levels of habitat disturbance have also led to weed and vermin invasion of stands with native dominated field layer species. There is likely to be an associated loss in native flora and ground fauna. The increasing rate of eucalyptus dieback at Simpson Barracks is a clear indication of loss of effective habitat links. The block contains a disproportionately high disturbed edge to interior habitat ratio. Further housing surrounding the barracks will increase this ratio.</p> <p>River Red Gum dieback. Fragmentation has contributed to the rising level of dieback and mortality rate of the River Red Gums. Foliage insect attack on the trees and regenerating saplings is considerable. A leaf sample taken from a defoliated sapling in 1990 contained three species of psyllids (Alan Yen pers. comm.) and the Gum-leaf Skeletoniser. Few saplings contained healthy leaves in 1992 and their likelihood of survival through a dry summer is poor as the foliage loss incurred from successive heavy infestation years would have reduced their root systems. Several mature trees observed in 1990 were dead on an inspection in 1992.</p>	<p>Implementation of the Simpson Barracks Land Management Plan. The land management plan was recently prepared by the Army in wide consultation with relevant departments and community groups. It outlines a series of management objectives and guidelines for the barracks. The south-western section containing River Red Gum woodland and grassland has been set aside from mowing by the Army to enable natural regeneration.</p> <p>Strengthen habitat links. So as to maintain biological values, management of the woodlands should address raising the long-term viability of populations of beneficial avian insectivore species. Connecting woodlands contain a higher species richness and density of insectivorous birds than fragmented, thinned or isolated remnants (Beardsell 1989; Bennett 1991).</p> <p>Eucalyptus dieback control. Increasing the density of trees and the structural and floristic diversity of shrubs will reduce the Noisy Miner and defoliating insect populations.</p>

Once dieback is initiated and land-use intensifies, its effects accelerate rapidly. Without adequate protective habitat management and restoration this may culminate in heavy tree mortalities. As a result of habitat fragmentation the stand now contains trees and young saplings in obvious ill-health which are undergoing premature decline (i.e. sparse crowns, branch dieback and leaf defoliation) caused by chronic and sustained insect attack. The elevated populations of leaf defoliating insects are due mainly to the absence of adequate numbers of forest-dependent insectivorous birds such as pardalotes and cuckoos. This is exacerbated by the dominance of Noisy Miners.

Forest insectivores, along with insect predators and parasites, regulate the numbers of leaf feeding insects (predominantly psyllids) and mediate the consequent rate of defoliation of trees in unfragmented stands of River Red Gum woodland (Beardsell 1989). The dense stand on Rentons Ridge along Yallambie Road in the north-east section of Simpson Barracks was in healthy condition when inspected in October 1990. This section contained the highest native understorey diversity on the barracks. At this time there was only a small population of Noisy Miners present. Breeding populations of beneficial species such as the Spotted Pardalote were present. On inspection in November 1992, the tree canopy cover and vigour had declined considerably and Noisy Miners were dominant (40–50 birds). No Spotted Pardalotes were present. Defoliation of the River Red Gums near Greensborough Road has become chronic.

Degradation of the River Red Gum understorey vegetation. Past livestock grazing, earthworks and grass cutting have disturbed most areas of understorey vegetation at Simpson Barracks. It has been cleared from stands along Greensborough Road. Areas that are intact (e.g. Rentons Ridge) are becoming weed invaded, particularly by Panic Veldt Grass, Cocksfoot and brome grasses. Sweet Vernal-grass and Yorkshire Fog are present throughout the grasslands.

Revegetation of open space to restore habitat links. Replanting on cleared land and promoting regeneration of understorey species will attract additional native bird species and raise the population levels of resident beneficial species such as the Spotted Pardalote, Grey Fantail and Superb Fairy-wren. Sections of the horse paddocks to the south-east of the barracks should be replanted to partially reconnect habitat links to the Plenty River.

Require diverse structure and floristics of understorey planting. This is essential to reversal the decline of faunal populations which control dieback. Broad understorey diversity will enable the grassy woodland invertebrate and vertebrate species populations to reach a more natural balance. Disturbed areas in the Greensborough Road River Red Gum woodland section are being stabilised and planted by the Army with species including the Blackwood, Prickly Moses, Wedge-leaf Hop-bush, Gold-dust Wattle and Black Sheoke. The shrubs are essential as this brings back the small insectivores which form hosts to the highly beneficial cuckoos. Dead trees and fallen limbs should not be removed as these form nesting sites for birds and shelter for reptiles.

Stream degradation. Gully erosion, salting, water pollution and turbidity and litter from upstream housing estates and roadway runoff is evident along Yallambie Creek at Simpson Barracks. The most serious weeds include Hawthorn, Cherry-plum, Montpellier Broom, Bulbil Watsonia, Cleavers, Wandering Jew, Drain Flat-sedge, Paspalum, Kikuyu Grass, Great Reedmace, Blue Periwinkle, English Ivy and Blackberry.

Other Issues

Absence of grazing/fire control. The grassy fuel load has built up in the long absence of grazing/fire and would present a local hazard in the event of an uncontrolled grassfire.

Weed and vermin control. Domestic cats enter the barracks from surrounding residential areas (Wayne Ellery pers. comm.). They are a substantial threat to ground fauna (including parrots), shrub birds and species such as the Tawny Frogmouth. This problem will remain (and increase with further housing development) until such time as companion animal control and responsible pet ownership is undertaken (see Volume 1). The barracks contain resident populations of foxes, rabbits and hares.

Problem areas in need of rehabilitation. Areas identified in the land management plan that are no longer required for use include the rubbish tip, disused sewerage farm, the range area and the old golf course. Each of these areas encroaches onto fragile or important native vegetation areas.

Fire management—ecological burning. In the absence of a natural grazing regime, grassland communities require periodic burning to maintain floristic diversity and structure. Carefully planned and conducted burns can also be used as a means of weed control. Mosaic burns are proposed in the land management plan. This would boost declining populations of Fabaceae species (e.g. Running Postman, Matted Bush-pea and Purple Coral-pea) which are dependent on burning to germinate seed. The section of Rentons Ridge between the tip and Molloy Road which contains these species should be burnt. The section contains tracks from which early summer burning could be conducted relatively safely.

Weed and vermin control. This is outlined in the land management plan. Woody weed control along Yallambie Creek will need to be carefully conducted. Follow-up planting is required as the alien shrubs presently stabilise the banks from further erosion.

The Army would be obliged to comply with government regulations regarding control of companion animals (Simpson Barracks Land Management Plan). Introduced animals also require control.

The Army intends to clean up and rehabilitate the rubbish tip area. Wetland weeds in the sewerage farm need to be controlled. Erosion control along Yallambie Creek and the drainage line through the sewerage farm is needed.

Community education. Education programs on nature conservation issues and the significance of the barracks woodlands and grasslands are proposed (Simpson Barracks Land Management Plan).

Land for Wildlife, Greening Australia and protection works by the Army. Sections of the barracks have been incorporated under the Land For Wildlife and Greening of Australia schemes. Weed removal and land protection works are conducted by Army staff. Management focus is directed toward revegetation and woody weed removal in native grassland areas. Extensive works have been conducted in the section near Greensborough Road. Target species have been Desert Ash, African Wattle and Patterson's Curse (Wayne Ellery pers. comm.). Rehabilitation of seasonal wetland vegetation (e.g. Veined Swamp Wallaby-grass, Common Blown Grass, Common Sedge and Common Tussock-grass) along upper Banyule Creek should also be conducted.

Natural Heritage woodland. The barracks woodlands should be nominated because of their importance as an intact relict of a formerly characteristic and widespread land and biological system near Melbourne now threatened and alienated by land-use.

YLAP C YARRA BEND–STUDLEY PARK

This management unit consists of one site of state faunal significance (site 29) and one of regional faunal significance (site 30) and surrounding land that forms habitat links. This unit lies outside the area covered by the five NEROC councils but lies within the study area of North East Melbourne. Systematic faunal and habitat survey was conducted in the management unit.

Map Reference: 7922 253130 to 7922 261158 (Yarra River).

Location/Size: The Yarra River and Yarra Bend Park from Barkers Road to Chandler Highway. Approximately 430 ha.

Municipality: Cities of Darebin, Boroondara and Yarra.

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands at the meeting point of the Merri and Plenty Volcanic Plains. Lava flows from the north followed the valleys of the Merri and Darebin creeks. The Yarra River flows along the boundary between the sedimentary hills of Kew to the east and the lava flows of Collingwood to the west.

Landforms

Alluvial plain: spurs, sedimentary cliffs and escarpments, plain-slopes (eastern side of the river at Kew), river valley, alluvial terraces, tributary confluence (Merri Creek) and weir (Dights Falls). Coastal plain: sand-crests. Volcanic plain: stony plains (above the river near Fairfield Hospital), basalt cliffs and escarpments. Elevation is 2–30 m.

Hydrology

See YLAP D and MLVP A.

Rainfall: 650 mm.

Site 29 Dights Falls

Due to time and contractual constraints, the sites have not been fully written up. Assessment keys on habitat and faunal significance and fauna lists are presented. The keys provide a systematic checklist assessment of the relevant biological significance parameters present in the two sites.

The site boundaries are shown on Map 1. This will enable comparisons with NEROC sites in the Yarra Lowland Alluvial Plains biophysical zone. Management discussions for the NEROC sites in the Yarra River Chandler Highway to Plenty River management unit are directly relevant to Yarra Bend/Studley Park as they are nearest neighbours along the Yarra River habitat link. See also the Regional Habitat Link and Hydrological Strategies in Volume 1.

Site 29 consists of the water of the Yarra River between Burnley Street and Dights Falls. The significance pertains to ichthyofauna (fish) values from 13 electrofish (EF) and five seine net (SN) surveys conducted between February 1991 and September 1992 in the 300 m section of the river immediately downstream of Dights Falls (Tarmo Raadik pers. comm.; Raadik in prep.).

Map Reference: 7922 252130 to 7922 238146 (Yarra River from Barkers Road to Dights Falls. One minute lat/long grids include 37°48' x 145°00'.

Municipality: Cities of Darebin, Boroondara and Yarra.

HABITAT SIGNIFICANCE: not assessed

FAUNAL SIGNIFICANCE: Site 29 Dights Falls

Assessment: State—Category 2 (B, D, E); Regional (C, D)

Reference grids for the significance keys include:

29^a: 37°48' x 145°00'; Yarra River downstream of Dights Falls

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 29^a: Tasmanian Mudfish (one by EF on 27 November 1991); Australian Grayling (repeated sightings): 7 of 13 EF and 5 of 5 SN

c. Rare fauna

Regional. 29^a: Spotted Galaxias: 3 of 13 EF (11 and 22 October 1991 and 21 November 1991); Broad-finned Galaxias: 2 of 13 EF (11 October 1991 and 21 November 1991) and 1 of 5 SN (16 February 1991); Pouched Lamprey: 1 of 13 EF (23 August 1992)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Freshwater fish

State. 29^a: 7 species by EF on 22 October and 21 November 1991; 6 species by EF on 20 February 1991 and 11 October 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

e. Freshwater fish

State. 29^a: 12 species: Short-finned Eel, Pouched Lamprey, Short-headed Lamprey, Common Galaxias, Broad-finned Galaxias, Spotted Galaxias, Tasmanian Mudfish, Australian Smelt, Australian Grayling, Australian Bass, Tupong and Flat-headed Gudgeon; this is the highest recorded single site diversity for freshwater fish in Victoria (Tarmo Raadik pers. comm.); the estuarine Black Bream was also recorded

E. REPRESENTATIVENESS: Significant Species—reference grid survey

b. Regionally endangered fauna (R1 species)

Regional. 29^a: 2 species. **Fish:** Pouched Lamprey, Tasmanian Mudfish

c. Regionally vulnerable fauna (R2 species)

Regional. 29^a: 5 species. **Fish:** Short-headed Lamprey (4 of 13 EF), Broad-finned Galaxias, Australian Smelt (3 of 13 EF and 3 of 5 SN), Tupong (6 of 13 EF and 1 of 5 SN), Flat-headed Gudgeon (3 of 13 EF and 4 of 5 SN)

d. Regionally rare fauna (R3 species)

Regional. 29^a: 3 species. **Fish:** Common Galaxias (13 of 13 EF and 5 of 5 SN; the 100% survey rate indicates the importance of this section for the species; their absence from surveys immediately upstream of Dights Falls is indicative of the effect of the weir as a migration barrier), Australian Bass (1 of 13 EF; apparently released into the Yarra), Black Bream

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 29^a: Australian Grayling: 17 by EF on 20 February 1991, 15 by EF on 23 January 1992, 60 by SN on 23 February 1991 and 20 by SN on 3 March 1991

Regional. 29^a: Broad-finned Galaxias: 39 by EF on 22 October 1991 and 10 by EF on 11 October 1991; Spotted Galaxias: 23 by EF on 22 October 1991 and 14 by EF on 21 November 1991

j. Electrofishing or netting rate

State. 29^a: four samples of over 1000 and another of over 500 (see *Fb/l/m*)

l. Regionally vulnerable fauna (R2 species)

Regional. 29^a: Short-headed Lamprey: 17 by EF on 11 October 1991; Tupong: 68 by EF on 23 January 1992 and 40 by EF on 4 March 1992

m. Regionally rare fauna (R3 species)

Regional. 29^a: Common Galaxias: over 1000 by EF on 4 occasions (20 February, 11 October, 22 October and 21 November 1991), 459 by EF on 23 January 1992 and 328 by EF on 4 March 1992

Outlook

The installation of an effective fish-way at Dights Falls is the most immediate objective. A trial stage installed in 1993 has improved the faunal significance of upstream sections of the Yarra, but is apparently not functioning effectively for some species (e.g. Common Galaxias). Without a fish-way, the Australian Grayling, Tasmanian Mudfish and Spotted Galaxias may have become extinct in the Yarra River system. Conservation practices must be upgraded; for instance an ichthyofauna conservation management plan should be prepared for the Yarra system. This should follow guidelines in the Regional Hydrological Strategy.

FAUNA

Rare or Threatened Fauna

(refer to descriptive texts under fauna in site 57 for Australian Grayling and site 64 for Broad-finned Galaxias)

Bb 29^a: Tasmanian Mudfish. This species is restricted on the Australian mainland to an area between Wilsons Promontory and Cape Otway. It appears to have dispersed from Tasmania during glacial episodes about 18 000 years ago, at a time of low sea level when a land bridge connected across Bass Strait (Koehn & Raadik 1991). The Yarra then joined the Tamar River, and flowed into the Southern Ocean south-east of Tasmania. The mudfish was first recorded in Victoria in 1980, at Wilsons Promontory and was subsequently recorded in 1990 in coastal river systems of the Otway Ranges. One individual was recorded downstream of Dights Falls on 27 November 1991 (Tarmo Raadik pers. comm.). This is the only record in the Port Phillip and Western Port region.

Tasmanian Mudfish are nocturnal and cryptic and inhabit dense submerged meadows and muddy substrates of the lower (freshwater) reaches of coastal streams, floodplain billabongs and near coastal swamps (Koehn & Raadik 1991). In drying ephemeral swamps they are capable of aestivating in damp mud under stones and logs. The section of the Yarra River below Dights Falls where the mudfish was taken formed a shallow mud and boulder rapid.

It is unknown whether mudfish are migratory between freshwater and saltwater or wholly freshwater. If migratory, the fry would undergo a marine juvenile development stage before returning to freshwater to mature and reproduce (Koehn & O'Connor 1990). They spawn in shallow floodwater in winter/early spring. Adult mudfish are slender and eel-like, with small fins adapted to foraging amongst dense submerged aquatic vegetation (Koehn & Raadik 1991). They are likely to eat small invertebrates and algae and possibly browse the substrate for organic detritus.

Large areas of potential habitat have been eliminated or degraded and the preservation of freshwater habitats is essential for the survival of Tasmanian Mudfish in Victoria (Koehn & Raadik 1991). It likely inhabited the floodplain billabongs of the Middle and Lower Yarra and backwater pools of rapids, protected by rock-bars (particularly the area where Tupongs were recorded near Pound Bend in site 57). The installation of the fish-way at Dights Falls may enable mudfish to recolonise these areas.

Bc **29^a: Pouched Lamprey.** This species is rare in Victoria, where it inhabits coastal drainages west of Lakes Entrance. They have a similar though more disjunct distribution than the Short-headed Lamprey, but occur in far fewer numbers (Koehn & O'Connor 1990). Pouched Lamprey are mainly associated with the upper reaches of streams (e.g. Upper Yarra) while the Short-headed Lamprey appear widespread throughout. They are rare in the Middle and Lower Yarra with the only recent record being a single animal electrofished downstream of Dights Falls on 23 August 1992. The last record from NEM was in the Yarra River near Yarra Glen in 1970 (Raadik in prep.). The only prior record was the 'Caledonia Diggings' (presumably Diamond Creek) at St Andrews in 1890.

Pouched Lamprey migrate through the Lower and Middle Yarra to spawning areas in the Upper Yarra. They burrow in mud, particularly amongst the roots of aquatic herbs (Koehn & O'Connor 1990). They spend a longer time at sea than the Short-headed Lamprey and usually grow to a larger size. Feeding behaviour and reproduction are similar to the Short-headed Lamprey (see site 57). The nest is usually ringed by stones.

Bc **29^a: Spotted Galaxias.** This species is rare in Victoria where it has a disjunct distribution over the coastal drainage systems (Koehn & O'Connor 1990). It also occurs in the South West of Western Australia, Tasmania and Bass Strait islands. The trans-Bassian fauna (also Broad-finned Galaxias, Southern Pigmy Perch and Freshwater Blackfish) are relicts of the late Pleistocene Ice Age (see Tasmanian Mudfish). The type locality of the Spotted Galaxias is the 'River Yarra near Studley Park' but there are only two records from the last 50 years in the Yarra system. These were single specimens taken from Badger Creek in the Upper Yarra and from downstream of Dights Falls on 15 November 1989, where they are very rare (Raadik in prep.).

The paperbark billabongs and gently-flowing backwaters of the Lower Yarra from Kew to Templestowe, Middle Yarra at Yering/Coldstream and Plenty River at Yan Yean probably formed their major breeding habitat in NEM. These were densely vegetated with Swamp Paperbark swamp scrub, Tall Spike-rush emergent herbfield and extensive submerged herbfields of pondweeds and Lake Eel-grass. Spotted Galaxias develop shoals which migrate between freshwater and seawater. The fry develop at sea and the transparent whitebait move to adult freshwater habitats from late October to early January. They are poor climbers and would have been unable to pass over the weir at Dights Falls to potential upstream breeding grounds.

Spotted Galaxias spawn in herbfield shallows of freshwater streams and lagoons on rising water and decreasing day length and temperature of late autumn and winter (Koehn & O'Connor 1990). Eggs are attached to the roots of emergent vegetation. High winter flows take the fry to productive coastal estuaries and inshore waters to develop, returning as juveniles in mid-spring. They were probably close to extinction in the Yarra River basin as they would be unlikely to breed in the stream downstream of Dights Falls.

The Spotted Galaxias has the appearance and foraging behaviour of a small Brown Trout. They are more thick-set than other local galaxias, growing to about 15 cm in length. They are moderate swimmers and often inhabit the quieter surface waters amongst reed-beds. Similar to trout, they retreat to the cover of bank overhangs, logs or vegetation when

disturbed. The diet is probably similar to that of the Broad-finned Galaxias, a combination of aquatic and terrestrial invertebrates.

Spotted Galaxias have declined appreciably throughout their range as riparian vegetation has been removed and degraded, wetlands have been drained and weirs and dams have been built along streams. They were eliminated from the Middle Yarra by the building of the weir at Dights Falls and the loss and degradation of breeding habitat at floodplain paperbark swamps. The establishment of a fish-way at Dights Falls is considered essential for the survival of this species in the Yarra, as it is for the Australian Grayling, Tasmanian Mudfish and Tupong (Tarmo Raadik pers. comm.). The development of Swamp Paperbark, Tall Spike-sedge, Floating and Blunt Pondweeds and Water-ribbons at Banyule and Bolin Billabong in Yarra Valley Park has been an important preparation for a potential population recovery. However, they may not re-establish in water containing large populations of Brown Trout and Roach because of competition and predation.

Site 30 Yarra Bend Park

This site contains Yarra Bend Park with the exception of the Yarra River downstream of Dights Falls, which is contained in Site 29.

Map Reference: 7922 238146 to 7922 261158 (Yarra River from Dights Falls to Chandler Highway). One minute lat/long grids include 37°47' x 145°00' to 145°01', 37°48' x 144°59' and 37°48' x 145°01'.

Municipality: City of Boroondara.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference stands: nil

Relatively intact and extensive stands: River Red Gum (riverbank) floodplain riparian woodland (16.2); Golden Wattle cliff/escarpment shrubland (20.4)

Partially intact or small stands: Yellow Gum box–ironbark woodland (12.3); Manna Gum escarpment woodland (13.1); River Red Gum (alluvial plain) grassy woodland (14.3); Woolly Tea-tree riparian scrub (18.2; lower Merri Creek)

Remnant, degraded or establishing stands: River Red Gum (volcanic plain) grassy woodland (14.1); River Red Gum (terrace) floodplain riparian woodland (16.3); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Rare species: Slender Tick-trefoil

Notable features: almost 200 native species have been recorded at Yarra Bend/Studley Park, making it one of the most diverse floras per unit area in inner Melbourne (Randall Robinson pers. comm.). An intensive weed control and revegetation program has consolidated the more intact habitat stands and expanded the degraded habitats and habitat links. Coastal dune and saltmarsh flora of the riverbank/escarpments include Rounded Noon-flower, New Zealand Spinach, Seaberry Saltbush, Common Boobialla and Austral Tobacco. Coastal sand-crest species include Wiry Spear-grass. Only natural occurrence of Gippsland Blue Gum in NEM.

FAUNAL SIGNIFICANCE: Site 30 Yarra Bend Park

Assessment: Regional—Category 1 (B, D, E, F)

Reference grids for the significance keys include:

30^a: 37°47' x 145°00'; Yarra Bend–Studley Park/upstream of Dights Falls

30^b: 37°48' x 145°00'; Yarra Bend downstream of Dights Falls

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Regional. 30^a: Regent Honeyeater (single bird in August 1994; listed Regional as now vagrant to inner Melbourne)

b. Vulnerable fauna

Regional. 30^{ab}: Swift Parrot (see *Fb*)

c. Rare fauna

Regional. 30^a: Barking Owl (several reports in 1988/1989 from near Alphington Boathouse), Powerful Owl (one calling at Studley Park on 28 April 1993; in recent years there have been several records of non-breeding birds over late summer–autumn from the Lower Yarra; these are mainly dispersing juveniles from the foothills; the calling bird at Studley Park would suggest an adult pair may have been present; the Yarra River provides a habitat link to suburban feeding areas for the owl).

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

I. Reptiles

Local. 30^a: 5 species including the White's Skink on the banks of the Merri downstream of Heidelberg Road on 10 April 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 30^a: over 115 species

b. Native birds

Regional. 30^a: over 90 species

c. Native mammals

Regional. 30^a: 10 species: Echidna, Platypus, Common Brushtail Possum, Common Ringtail Possum, Sugar Glider, Grey-headed Flying-fox, Gould's Wattle Bat, Lesser Long-eared Bat, Little Forest Bat and Water Rat

d. Herpetofauna

Regional. 30^a: 15 species: Murray River Tortoise, Marbled Gecko, Gippsland Water Dragon, Tree Dragon, Common Blue-tongued Lizard, Cunningham's Skink, White's Skink, Garden Skink, Weasel Skink, Southern Water Skink, Tussock Skink, Large Striped Skink, Bougainville's Skink, Tiger Snake and Southern Brown Tree Frog

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 30^a: 22 species

b. Regionally endangered fauna (R1 species)

Regional. 30^a: 2 species. **Birds:** Peaceful Dove, Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

Regional. 30^a: 3 species. **Birds:** Barking Owl, Azure Kingfisher, Fuscous Honeyeater

d. Regionally rare fauna (R3 species)

Regional. 30^a: 7 species. **Birds:** Darter, Collared Sparrowhawk, Pink Robin. **Mammals:** Grey-headed Flying-fox. **Reptiles:** Murray River Tortoise, Marbled Gecko, Gippsland Water Dragon

e. Regionally depleted fauna (R4 species)

Regional. 30^a: 10 species. **Birds:** Brown Quail, Whistling Kite, Peregrine Falcon, Powerful Owl, Swift Parrot, Bassian Thrush, White-winged Triller, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink

f. Regionally restricted fauna (R5 species)

Regional. 30^a: 15 species. **Birds:** Australian Pelican, Great Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Rose Robin, Olive Whistler. **Mammals:** Water Rat. **Reptiles:** Cunningham's Skink, Large Striped Skink, Bougainville's Skink, Tussock Skink

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

Regional. 30^a: Swift Parrot (12 in flowering Yellow Gum north of Studley Park Road on 31 March 1988)

Regional. 30^b: Swift Parrot (20 by Yarra Boulevard south of Studley Park Road on 4 September 1989)

o. Regionally restricted fauna (R5 species)

Regional. 30^a: Water Rat (trapped upstream of Studley Park on four occasions; substantial population)

Outlook

The faunal significance may decline from Regional Category 1 to Category 2 due to an inability of fauna in the habitat refugia to cope with rising levels of impact from humans. There is a relatively intact riparian habitat link upstream to site 31

but a degraded habitat link exists up the Merri Creek to site 6. Improvement of the upstream habitat link is the key to survival of many bird species and the Sugar Glider. Ground fauna, particularly reptiles, are under threat from predation and habitat loss, fragmentation and disturbance.

FAUNA

Rare or Threatened Fauna

(refer to descriptive texts under fauna in site 40 for Regent Honeyeater, site 42 for Swift Parrot, site 68 for Barking Owl and site 83 for Powerful Owl)

Other Significant Fauna

Birds

30^a: Yarra Bend bird list. The list has been extracted from the Yarra Bend Park Management Plan (1990), which had been provided to the Yarra Bend Park Trust by Mr Fred TH. Smith of Kew, compiled from 50 years of local observations. A summary of significant sightings with annotations was kindly prepared for this study by Mr Smith (additional information from the management plan and further comments by this author are bracketed).

This list has been split into three time periods. Historical: (1940 to 1969;= H). Recent: (1970 to 1985; = R). Contemporary: (1986 to 1994;= C). Migratory species from the recent period which Mr Smith suspects still visit YBP, are included as contemporary in this analysis. Several rare honeyeater observations from the recent period were of vagrants in the winter following the 1982/83 drought. The bird list contained 129 native species (of which 57 were recorded breeding), with 91 of these species recorded over the contemporary period.

- Brown Quail: C; 1 record of 3 vagrants near Yarra Boulevard west of Kew Cottages
- Painted Button-quail: H, R; mainly noted in Golden Wattle groves at Studley Park (became rare and no longer visits)
- Peaceful Dove: H, C (1986); 2 records of nomadic occurrence and not aviary escapee; also in Yellow Gum box–ironbark woodland (12.3) west of Royal Talbot on 22 February 1990 (Richard Hill pers. comm.)
- Bar-shouldered Dove: H; 1 with turtle-doves—likely aviary escapee
- Brush Bronzewing: H, R; scarce visitor—years apart
- Great Crested Grebe: H; up to 4 on Yarra for a few days—none since
- Australasian Grebe: H; (occasional visitor)
- Darter: H, R, C; more regular visitor in past few years (since establishment of a breeding colony upstream at Kew Golf Club)
- Australian Pelican: R, C; vagrants pass over occasionally—sometimes on water for days to weeks in later years
- Banded Lapwing: H; one old record
- Eastern Curlew: H; odd bird on migration north and south—calling at night
- Greenshank: H; as preceding—once on Yarra Bend Golf Course
- Latham’s Snipe: H; vagrant—once near mouth of Merri Creek
- Nankeen Night Heron: H, R, C; small colonies in River Red Gums occasionally—presently (8.94) near Kane’s Footbridge
- Swamp Harrier: H, R; vagrant
- Grey Goshawk: H, R; 1 bird on 5/6/1983 and historical by others
- Collared Sparrowhawk: H, R, C; scarce autumn/winter visitor
- Wedge-tailed Eagle: H, R; two observations—passing over
- Little Eagle: H, R, C; rare vagrant—usually passing over
- Whistling Kite: H, R, C; occasionally seen—mostly passing over
- Australian Hobby: H, R, C; often seen (breeding resident)
- Peregrine Falcon: H, R, C; odd birds noted occasionally—passing over
- Black Falcon: H; extremely scarce vagrant—1 or 2 old records
- Purple-crowned Lorikeet: H, R, C; still occasionally visit flowering Yellow Gums
- Little Lorikeet: H, R, C; as preceding

- Long-billed Corella: H, R; pair used to breed in River Red Gums near Eastern Freeway bridge over Yarra
- Superb Parrot: H; 2 wild birds in River Red Gums for a few days in the 1940s
- Swift Parrot: H, R, C; common annual autumn/winter visitor to Yellow Gums in early years—now very scarce to absent
- Red-capped Parrot: H; (old records of aviary escapees)
- Azure Kingfisher: H, R, C; formerly resident and breeding—now absent but for the odd rare vagrant
- Fork-tailed Swift: H, R; sometimes passes over in hundreds—usually late summer—not as regular as the needletail
- Rufous Fantail: H, R, (C); probably pass through each year on migration
- Leaden Flycatcher: H; 2 old records (spring/summer vagrant)
- Pink Robin: H, C; 3 or 4 observations—probably visit every autumn/winter
- Rose Robin: H, R, (C); as preceding
- Olive Whistler: H, R, (C); 2 or 3 observations—probably rare annual autumn/winter visitor
- Bassian Thrush: H, C; very rarely noted—probably annual autumn/winter visitor
- White-winged Triller: H, R, C; occasional spring/summer breeding migrant—more plentiful in early years
- Rufous Songlark: H, R, C; formerly annual spring/summer breeding migrant—now rare and not seen for several years
- Masked and White-browed Woodswallows: H, R; pass over occasionally in early summer after hot north winds—one year both species built nests and some eggs were laid—for some unknown reason, all the woodswallows suddenly abandoned their nests and left
- Brown Treecreeper: H; 1 record from the 1940s—locally extinct
- Tawny-crowned Honeyeater: R; 6 birds on 17 May 1983—remained several days
- Fuscous Honeyeater: H, R, C; formerly annual autumn/winter visitor to flowering Yellow Gums—now rare
- Yellow-tufted Honeyeater: R; small numbers visited the flowering Yellow Gums in May/June 1983
- Yellow-plumed Honeyeater: R; 3 birds together on 3 June 1983
- Regent Honeyeater: H, R, C; formerly visited in small numbers and occasionally bred—now absent except for one current record (single bird quarrelling with Red Wattlebirds in flowering Yellow Gum box—ironbark woodland north of Studley Park Road in August 1994; Damien Cook pers. comm.)
- Little Friarbird: H; 2 records in the early years
- Diamond Firetail: H; record from the 1940s of 3 together—locally extinct

YLAP D YARRA RIVER CHANDLER HIGHWAY TO PLENTY RIVER

This management unit consists of one site of state faunal significance (site 33) and two of regional faunal significance (sites 31 and 32) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 250158 to 7922 324202 (Yarra River).

Location/Size: Yarra River valley from Chandler Highway to the mouth of the Plenty River. Approximately 730 ha.

Municipality: Cities of Banyule (north side upstream of Darebin Creek), Darebin (north side downstream of the Darebin Creek), Boroondara (south side downstream of Koonung Creek) and Manningham (south side upstream of Koonung Creek).

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands. It flanks the volcanic plains downstream of Darebin Creek. Undulating lowland hills lie to the north-east.

Landforms

Alluvial plain: plain-slopes, river escarpments, creek confluences, drainage lines, river valley, alluvial floodplain, terraces, billabongs, shallow freshwater marsh (Banyule Swamp) and artificial floodplain wetlands (e.g. Trinity Grammar lake at Bulleen). Volcanic plain: basalt escarpment on west side of Yarra downstream of the Darebin Creek. Elevation is 5–40 m.

Hydrology

The Yarra River is a large, perennial stream with sections of faster-moving rapids and slow-flowing deep water pools (to 6 m depth), lined with reeds. It has formed a mature stream valley and the most extensive floodplain and billabong system in the Lower Yarra. As the Yarra reformed its course over the floodplain, it left behind the closed billabong system of the old watercourse. There are over 30 billabongs shown along the floodplain between Chandler Highway and Burke Road on early survey maps. The area formed part of a vast and diverse wetland system. Those surviving include Willsmere Lagoon, Bailey Billabong, Kew Golf Club Billabong, Bolin Billabong and Banyule Billabong. They were each fed by small creeks and surrounded by extensive low-lying marshland. Most of the creeks have been diverted into drains and the marshland has been reclaimed for playing fields. Most of the billabongs are inundated when the river floods but are closed from the river at other times. In big floods every five to seven years most of the low-lying sections of the floodplain are inundated with up to 1 m of water.

There are two perennial tributaries of the Yarra, Koonung and Darebin creeks. The Koonung enters the Yarra via a narrow gorge which winds its way over a broad floodplain. This was probably the most extensive area of floodplain marshland in the Lower Yarra. The Darebin enters the Yarra from a small gorge, on leaving the basalt plains. Banyule (Salt) Creek and Glass Creek were formerly ephemeral but are now fed from urban runoff in times of low summer–autumn flow. They enter the Yarra through flats. Banyule Swamp has developed in the flats of the Banyule Creek. It is approximately 3 ha and is classified as a shallow freshwater marsh. In normal years the southern end is permanent, carrying water 0.5–1 m deep. It is the only extensive natural freshwater marsh remaining in the Lower Yarra.

Rainfall: 660 mm.

Site 31 Bailey Billabong, Willsmere Lagoon and Hays Paddock

Map Reference:	7922 266155 to 7922 293165 (Yarra River); 7922 273162 to 7922 269167 (Darebin Creek); 7922 282167 (Bailey Billabong); 7922 289161 (Kew Golf Club Billabong); 7922 288154 (Hays Paddock along the lower Glass Creek); 7922 277156 (Willsmere Lagoon). One minute lat/long grids include 37°46' x 145°02' to 145°03' and 37°47' x 145°02' to 145°03'.
Location/Size:	Yarra River valley from La Trobe Golf Club to Burke Road and Darebin Creek downstream of Heidelberg Road. Approximately 260 ha.
Municipality:	Cities of Darebin (La Trobe Golf Club and lower Darebin Creek on west/north side of river), Banyule (remainder of north side of river) and Boroondara (south side of river).
Land Tenure/Use:	Public: municipal land including Chelsworth Park–Wilson Reserve, Ivanhoe Public Golf Course and the Irvine Road sports fields (City of Banyule) and Hays Paddock and Willsmere Park (City of Boroondara). Wilson Reserve is one of the oldest parks along the Yarra, being established over 70 years. It was originally acquired for the scouting movement. The adjoining Chelsworth Park and Ivanhoe Municipal Golf Course formed part of Irvine’s dairy farm from 1910 to 1946. Heidelberg City Council purchased the area in 1948. Hays Paddock formed part of the Kilby Road dairy farm. It was purchased by Kew City Council around 1970. Private: Kew, Greenacres and La Trobe Golf Clubs and adjoining residential blocks.
Landforms:	Alluvial plain and volcanic plain (see YLAP D). Elevation is 5–30 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference stands: nil

Relatively intact and extensive stands: River Red Gum (billabong) floodplain riparian woodland (16.1); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Partially intact or small stands: River Red Gum (riverbank) floodplain riparian woodland (16.2); River Red Gum (terrace) floodplain riparian woodland (16.3); Swamp Paperbark swamp scrub (17.1); Creeping Knotweed–Matted Water Starwort (billabong mudflat) seasonal wetland (25.6); Blunt Pondweed permanent wetland (26.1)

Remnant, degraded or establishing stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2; eliminated from The Boulevard area); Long-leaf Box–Manna Gum escarpment woodland (13.1); River Red Gum (volcanic plain) grassy woodland (14.1; eliminated from the west side of the lower Darebin Creek); River Red Gum (alluvial plain) grassy woodland (14.3); River Red Gum (creek) floodplain riparian woodland (16.6); Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1; eliminated by sports fields at Chelsworth Park); River Red Gum (plains) drainage line woodland (30.1)

Notable features: Swamp Paperbark at Willsmere Lagoon (largest surviving stand in YLAP). Seasonal/permanent wetland vegetation at Bailey Billabong and Willsmere Lagoon.

FAUNAL SIGNIFICANCE: Site 31 Bailey Billabong–Willsmere Lagoon–Hays Paddock

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

31^a: 37°46' x 145°02'; Darebin Creek, Wilson Reserve, Bailey Billabong–Chelsworth Park

31^b: 37°47' x 145°02'; La Trobe/Green Acres Golf Clubs–Willsmere Lagoon

31^c: 37°47' x 145°03'; Hays Paddock–Kew Golf Club Billabong

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Regional. 31^a: Regent Honeyeater (Clark Road on 6 March 1990)

c. Rare fauna

Regional. 31^a: Baillon's Crake, Barking Owl. **31^c:** Broad-finned Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 31^c: 24 species at Hays Paddock/Kew Golf Club Billabong on 5 June 1992

Regional. 31^a: 15 species at Bailey Billabong on 11 January 1991

d. Breeding waterfowl

Regional. 31^a: 5 species including the Australasian Grebe, Eastern Swamphen, Dusky Moorhen, Pacific Black Duck and Chestnut Teal at Bailey Billabong on 11 January 1991

f. Breeding migratory insectivores

Local. 31^a: 6 species including the Olive-backed Oriole and Sacred Kingfisher at Bailey Billabong on 11 January 1991

g. Breeding parrots

Regional. 31^a: 6 species including the Rainbow Lorikeet, Musk Lorikeet and Red-rumped Parrot in River Red Gums at Bailey Billabong/Ivanhoe Golf Course on 11 January 1991

h. Bats

Local. 31^a: 4 species trapped at Wilson Reserve on 12 January 1991

k. Frogs

Regional. 31^a: 6 species including the Peron's Tree Frog and Victorian Smooth Froglet at Wilson Reserve on 16 January 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 31^a: over 120 species

b. Native birds

Regional. 31^a: over 100 species. **31^c:** 73 species

c. Native mammals

Regional. 31^a: 8 species

d. Herpetofauna

Regional. 31^a: 13 species (8 frogs)

e. Freshwater fish

Regional. 31^a: 2 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 31^a: 13 species. **31^c:** 5 species. **31^b:** 4 species

b. Regionally endangered fauna (R1 species)

Regional. 31^a: 1 species. **Birds:** Regent Honeyeater

Regional. 31^b: 1 species. **Birds:** Little Friarbird

Regional. 31^c: 1 species. **Birds:** Dollarbird

c. Regionally vulnerable fauna (R2 species)

Regional. 31^a: 3 species. **Birds:** Barking Owl, Azure Kingfisher. **Frogs:** Peron's Tree Frog

Regional. 31^b: 2 species. **Birds:** Baillon's Crake, Spotless Crake

Regional. 31^c: 1 species. **Fish:** Broad-finned Galaxias

d. Regionally rare fauna (R3 species)

Regional. 31^a: 5 species. **Birds:** Darter, Fork-tailed Swift, White-browed Woodswallow. **Fish:** Common Galaxias.
Butterflies: Consimilis Blue

Regional. 31^c: 2 species. **Birds:** Great Crested Grebe, Darter

e. Regionally depleted fauna (R4 species)

Regional. 31^a: 3 species. **Birds:** Latham's Snipe, Peregrine Falcon, Australian King-Parrot, Bassian Thrush

Local. 31^b: 1 species. **Birds:** Peregrine Falcon

Local. 31^c: 1 species. **Birds:** Whistling Kite

f. Regionally restricted fauna (R5 species)

Regional. 31^a: 12 species. **Birds:** Australian Pelican, Great Egret, Cattle Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Rose Robin

Local. 31^c: 7 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Little Lorikeet. **Mammals:** Water Rat

Local. 31^b: 6 species. **Birds:** Great Egret, Nankeen Night Heron, Australian Hobby, Rainbow Lorikeet. **Reptiles:** Common Long-necked Tortoise, Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 31^a: Rainbow Lorikeet (River Red Gum hollow at Ivanhoe Golf Course on 11 January 1991)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 31^a: 5 Latham's Snipe at Chelsworth Park Swamp on 11 January 1991

b. Rare or threatened fauna

Regional. 31^c: 14 adult Broad-finned Galaxias electrofished from Glass Creek at Hays Paddock on 6 March 1992

c. Waterfowl

Local. 31^c: 63 birds at Kew Golf Club Billabong on 5 June 1992

f. Frogs

Regional. 31^a: over 200 Victorian Smooth Froglets, 50 Verreaux's Tree Frogs and 50 Southern Brown Tree Frogs at Wilson Reserve on 8 April 1988 and 18 May 1992

Local. 31^b: over 30 Striped Marsh Frogs at Willsmere Lagoon on 10 April 1989 and 30 Victorian Smooth Froglets at Willsmere Lagoon on 26 May 1988

g. Rare/restricted colonial fauna

Regional. 31^c: restricted colonial roosting colony of 53 waterbirds (8 Darter, 13 Australian Pelican, 1 Royal Spoonbill, 1 Great Egret and 30 Nankeen Night Heron) at Kew Golf Club Billabong on 5 June 1992

Regional. 31^c: restricted colonial bird breeding colony of 37 Darter (15 adult, 11 unfledged young and 11 newly fledged young) at Kew Golf Club Billabong on 17 March 1995

Regional. 31^c: restricted colonial bird breeding colony of five pair of Nankeen Night Heron along the Yarra near the confluence of Glass Creek on 20 November 1993

Regional. 31^c: colonial roosting colony of 92 waterbirds (7 Yellow-billed Spoonbill, 15 White-faced Heron, 1 White-necked Heron, 16 Cattle Egret, 30 Australian White Ibis, 2 Straw-necked Ibis, 1 Great Cormorant, 10 Little Black Cormorant and 10 Little Pied Cormorant) at Kew Golf Club Billabong on 5 June 1992

Outlook

The highest ranking Regional Category 1 site (21 sub-criteria) in NEM. Under improved management several sub-criteria could upgrade to State significance. Under current management the significance will possibly decline due to habitat fragmentation and disturbance (particularly ground fauna such as reptiles). Control of human/dog disturbance would enhance breeding waterbirds.

FAUNA

Rare or Threatened Fauna

- Ba* **31^a: Regent Honeyeater.** One briefly visited a garden at Clark Road on 6 March 1990 and was promptly chased away (uttering a loud, high-pitched call) by Red Wattlebirds (Anthea Fleming pers. comm.). The species had not been seen locally over the previous two decades. The occurrence is treated as vagrant, but is designated with Regional significance given the rarity of sightings of the species in the 1990s.
- Bc* **31^a: Baillon's Crake.** One amongst Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at Bailey Billabong on 11 January 1991. This area and the swamp on the drainage line between Chelsworth Park and Wilson Reserve (Chelsworth Park Swamp) provide dense, reedy habitat and would likely support the Little Bittern and Lewin's Rail from time to time.
- Bc* **31^a: Barking Owl.** Lower Darebin Creek in late 1989 (Ed Thexton and Anthea Fleming pers. comm.). The species was also reported around the same time near Alphington Railway Station (Ian Rasmussen pers. comm.) and from downstream of Chandler Highway at the Alphington boat house in the Yarra Bend site (Ian Mansergh pers. comm.).
- Bc* **31^c: Broad-finned Galaxias.** Fourteen adults were electrofished from a drain section of the lower Glass Creek at Hays Paddock North Kew on 6 March 1992 (Raadik in prep.). The water and habitat quality (both instream and riparian) is clearly unsuitable for breeding of this species, but may provide important temporary feeding habitat. Further study is warranted as this is the largest population of this rare species recorded upstream of Dights Falls in the Yarra River system.

Other Significant Fauna

Birds

- Cg* **31^a: Breeding parrots.** Six species including the Rainbow Lorikeet, Musk Lorikeet and Red-rumped Parrot were nesting in River Red Gum (billabong) floodplain riparian woodland (16.1) around Bailey Billabong and a billabong by Ivanhoe Golf Course on 11 January 1991. The billabongs are important for parrots.
- Eb* **31^c: Rare inland migrants—Dollarbird.** Two in the dead River Red Gums at Kew Golf Club Billabong in November 1989. The Dollarbird and Little Friarbird are spring–summer migrants. They have declined steadily in GM over the last two decades. Both were formerly more common along the Yarra several decades ago but the above sightings constitute the only ones made for either downstream of Pound Bend in the last 10 years.
- Eb* **31^b: Rare inland migrants—Little Friarbird.** Two in River Red Gum (riverbank) floodplain riparian woodland (16.2) along the Yarra near La Trobe Golf Course on 10 April 1989 (see Dollarbird).
- Ec* **31^a: Spotless Crake.** One amongst Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at Chelsworth Park Swamp on 11 January 1991.
- Ec* **31^a: Azure Kingfisher.** One in River Red Gum (billabong) floodplain riparian woodland (16.1) at Bailey Billabong on 30 April 1991. This species is rare in the Lower Yarra and visits primarily in autumn–winter. Alien fish including Roach and Mosquito Fish would form important prey for the kingfisher.
- Ed* **31^c: Great Crested Grebe at Hays Paddock Wetland.** This wetland of about 0.5 ha supports Common Reed–Cumbungi–Tall Spike Sedge seasonal wetland (25.7) and usually about 50 waterbirds of about eight common species. It is occasionally visited by Australian Pelicans and on one occasion (14 May 1988) a Great Crested Grebe was present. Trapping of the Mallards and other hybrid ducks should be considered.
- Ee* **31^a: Latham's Snipe.** Five flushed from Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at Chelsworth Park Swamp on 11 January 1991. Small numbers of snipe annually visit the site. The conversion of

grazing land to playing fields, the mowing of wetland fringes and increasing visitor pressure from humans and dogs has affected this species. Its long-term viability, as indeed that of the other rare, cover-dependent waterbirds, will need active conservation management.

Fg **31^c: Darter and Nankeen Night Heron breeding colonies.** There is a newly established Darter breeding colony at Kew Golf Club Billabong. The nearest known breeding colony is at Lake Borrie on Werribee Sewage Farm. Birds commenced nesting around mid-December 1994. By mid-January 1995, seven nests forming a loose colony had been constructed and most contained newly hatched chicks or adults sitting on eggs. On 17 March 1995, the colony comprised 15 adults, 11 unfledged young and 11 newly fledged young (Damien Cook pers. comm.). The nests were platforms of sticks and leafy branches on the limbs of dead River Red Gums standing in the wetland. A minimum level of disturbance from humans needs to be maintained for nesting to continue.

Three breeding pair of Little Pied Cormorants were also present at Kew Golf Club Billabong on 17 March 1995. There was one nest with a sitting adult and another two with five newly hatched chicks (Damien Cook pers. comm.). The cormorant nests were placed in shrubs by the waters' edge. Little Black Cormorants were also present amongst the colony and may breed in the future.

The golf course area of North Kew/Ivanhoe originally contained over 20 billabongs and likely formed one of the most important non-coastal habitats in GM for waterbirds (including the locally extinct Brolga and Magpie Goose). Half of the billabongs are infilled and the remainder are degraded. The billabong at Kew Golf Club was dammed in the 1960s to form an artificial lake. Flooding killed the River Red Gums but these now provide the most significant arboreal waterbird roost and breeding area in NEM. Roosting species include herons, egrets, spoonbills, ibis, cormorants and pelicans (particularly when on visit during inland droughts). There are normally around 100 birds present including up to 50 Darters and cormorants. The nocturnal roost at the lake builds to several hundred birds from late autumn to early spring when ibis and Cattle Egrets are present.

A Nankeen Night Heron breeding colony was located nearby along the Yarra at the confluence of Glass Creek on 20 November 1993. This consisted of five breeding pair. The nests were a loose construction of twigs, wedged into forks of Silver Wattles and willows. Another 10–15 non-breeding birds were camped in the shrubbery by the river. European Carp, which abound in the billabongs, form important prey for the night herons and cormorants. The establishment of local breeding colonies of Darters and Nankeen Night Herons has led to an increased level of sightings along the Yarra in recent years. Revegetation programs have facilitated the dispersal of birds through the system.

31^a: Chelsworth Park–Wilson Reserve birdlist. An extensive birdlist of 98 native species seen in the area from 1970–1982 was provided by Anthea Fleming (VORG NOTES 18:2, December 1982). Eighteen of these have not been recorded while the same number of new birds have been added over the 1986–96 period. Most of the species not recorded may still visit but have become very rare in the Lower Yarra. A few, including the Painted Snipe, would no longer visit as the wetland vegetation has become too closed. A few, such as the Eurasian Coot, Black-fronted Dotterel, Royal Spoonbill and Clamorous Reed Warbler which occur on open wetlands in the site (e.g. Kew Golf Club Billabong), have not been seen in recent years at Bailey Billabong–Chelsworth Park Swamp (Anthea Fleming pers. comm.).

Bailey Billabong and Chelsworth Park Swamp are lined with River Red Gum (billabong) floodplain riparian woodland (16.1) and Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7). The water is becoming eutrophic and the vegetation has reached a closed, late successional stage. Tall Spike-sedge, which was dominant in the 1970s, is now rare.

The billabongs are inundated when the river floods most years. In big floods every five to seven years most of the low-lying sections of the floodplain are inundated. The area provides a diverse riverine and billabong waterbird assemblage and is well known to bird watchers. The herbfield cover provided by Bailey Billabong and Chelsworth Park Swamp supports crakes, snipe and possibly occasional rails and bitterns. The wetlands contain a diverse frog assemblage which provide prey for larger waders such as herons.

A summary of significant sightings and comments and additions to the birdlist for the contemporary (1986–96) period from a recent interview with Anthea Fleming is as follows (C = contemporary sighting):

- Common Bronzewing (C): first sighting of one bird by Bailey Billabong amongst Common Tussock-grass in wattle plantations in late summer 1996
- Baillon's Crake: few sightings—cryptic
- Spotless Crake (C): summer 1981–82 and spring 1992—cryptic, breeding
- Australian Pelican (C): numbers fluctuate, occasional winter influxes in inland droughts, otherwise as single birds flying over
- Caspian Tern: once in October 1980 after gales
- Painted Snipe: once in January 1973
- Royal Spoonbill: once in November 1972
- Great Egret (C): occasional winter migrant; usually as single birds with two seen in 1996
- Chestnut Teal (C): first appeared in 1985 and numbers have steadily increased to being common; 2 or 3 pair breed at Bailey Billabong
- Swamp Harrier: once in May 1982
- Collared Sparrowhawk: occasional 1970-82
- Australian Hobby (C): rare/occasional
- Peregrine Falcon (C): occasional winter sightings; not breeding locally
- Rainbow Lorikeet (C): appeared in late 1980s and has since undergone a dramatic increase (e.g. ornamental flowering eucalypts and fruit trees such as plums); may have contributed to the decline of Red-rumped Parrots by competing for nest hollows
- Purple-crowned/Little Lorikeet (C): flocks in ornamental Red-flowering Gums and Sugar Gums in summer 94/95
- Long-billed Corella (C): 30-40 in a flock passing through on 19 January 1995
- Australian King-Parrot (C): odd single bird
- Azure Kingfisher (C): occasional winter visitor prior to two birds being seen at Chelsworth Park in Feb-March 1996
- Sacred Kingfisher (C): have become less common at billabongs and used to nest in willows on the lower Darebin Creek
- Rufous Fantail (C): passage migrant in November of last three years only
- Rose Robin (C): single bird in brown plumage first seen in winter 1995 near Yarra end of Bailey Billabong
- Bassian Thrush (C): single bird first seen in winter 1995; probing for earthworms in soft ground near track by Bailey Billabong
- White-winged Triller: occasional summer migrant 1970-82
- Rufous Whistler: once on 3 May 1981
- Leaden Flycatcher: once in August 1970
- Rufous Songlark: occasional summer migrant 1970–82
- Little Friarbird: once in November 1978
- White-browed Woodswallow (C): occasional summer passage migrant (e.g. October 1980 and November 1982 and once or twice 1986–96)
- Red-whiskered Bulbul (C): this alien was not seen prior to recent years (e.g. escarpment shrubbery between The Boulevard and Wilson Reserve); only record for NEM

Decline of grassy woodland birds, open wetland birds and some annual migrants from the mountains. The vegetation structure and avifauna composition has undergone a change over the 25 years. The area had been a dairy farm until just after World War II. Around 1950, Ivanhoe Golf Course and Chelsworth Park were established. The structure of the grassland changed from rough paddocks to mown playing fields. In timbered areas the structure changed from open grassy woodland to dense scrub (including Blackberry) regeneration, particularly near the Yarra and billabongs.

Grassland and grassy woodland birds including the White-faced Heron (used to breed), Australian White Ibis, Australian Kestrel, Sulphur-crested Cockatoo, Galah, Red-rumped Parrot, Yellow-rumped Thornbill and Richard's Pipit have become less common, some appreciably (Anthea Fleming pers. comm.). Due to the successional closing of vegetation at billabongs, marshland passerines, including the Little Grassbird, which were common have become rare.

Others such as the Clamorous Reed Warbler and waders such as the Royal Spoonbill no longer visit (Anthea Fleming pers. comm.). Declining water quality would also be a contributing factor.

Some mountain visitors, including the Gang-gang Cockatoo, Golden Whistler, Flame Robin and Spotted Pardalote, have become rarer (Anthea Fleming pers. comm.). Urban pressure on fragmentation of habitat links and habitat degradation has affected these (e.g. stream banks and Spotted Pardalote breeding sites). The pardalote may have also declined due to the Noisy Miner becoming common on the golf courses. In some cases the decline of weeds which provided habitat for native species has been a contributing factor (e.g. thistle seeds for parrots, Hawthorn fruit for cockatoos and willows for nest hollow birds).

Recruitment of forest birds and annual migrants and some waterbirds. Several forest birds, including the Yellow-tailed Black-Cockatoo, Rose Robin, Bassian Thrush, Pied Currawong and Grey Currawong (resident), have appeared only in recent years (Anthea Fleming pers. comm.). Some of these arrive from the ranges in early April to spend the winter in the Lower Yarra. The Rose Robin was seen in winter 1995. This species is normally a spring–summer migrant, but stragglers such as this bird stay for winter. The retention of riparian habitat links to the mountains will be critical for these birds as outer fringe areas undergo urban development. Some waterbirds, such as the Chestnut Teal, which inhabit closed wetlands have established since the mid-1980s and are now common and breeding.

Mammals

Ef **31^c: Water Rat.** One recorded by Kew Golf Club on 10 April 1989. Probably fairly common along the river.

31^a: Sugar Glider. One in River Red Gum (plains) drainage line woodland (30.1) at Wilson Reserve while spotlighting in January 1988. The range of this species has become fragmented in the Lower Yarra. It now appears restricted to areas where box–ironbark woodland or grassy woodland flanks the river (e.g. Wilson Reserve and Yarra Bend).

31^a: Bats. Four species including the Large Forest Bat, which is rare close to Melbourne, were trapped at Wilson Reserve on 12 January 1991. A colony of Gould’s Wattle Bats is known to roost under the floorboards of a verandah at nearby Hardy Terrace (Betty Dowell pers. comm.).

Reptiles

31^a: Lizards and snakes. Most species have become scarce due to disturbance, predation and habitat loss associated with land settlement and human recreation activities. The Common Blue-tongued Lizard and Weasel Skink were located under debris in River Red Gum floodplain riparian woodland (16.3) on the floodplain terrace while occasional Southern Water Skinks occur in River Red Gum floodplain riparian woodland (16.2) along the river. The only snake recorded was the Tiger Snake. The Eastern Brown Snake, Lowland Copperhead and Red-bellied Black-Snake are presumed to be locally extinct.

The rare Glossy Grass Skink would have probably occurred amongst Swamp Paperbark swamp scrub (17.1) around the billabongs (see Bolin Billabong; site 32). Replanting of paperbarks and the development of branch debris above the high water mark may enable its re-introduction. Other species that may still occur in remnant River Red Gum grassy woodland (14.3) at the golf courses include the Tussock Skink and Delicate Skink.

Frogs

Ec **31^a: Peron’s Tree Frog—biogeographical overlap and frog diversity.** The faunal overlap occurring in the site is most aptly illustrated by the frogs and their habitats. Eight species have been recorded in the Wilson Reserve–Bailey Billabong–Ivanhoe Golf Course area. Peron’s Tree Frog inhabits River Red Gum (billabong) floodplain riparian woodland (16.1) and Swamp Paperbark swamp scrub (17.1). The occurrence of this frog in the Yarra and Plenty River systems is disjunct from occurrences in the Murray–Goulburn riverine plains and the coastal rivers of East Gippsland. Likewise, Swamp Paperbark does not occur west of Melbourne in Victoria. Three subspecies of the Common Bullfrog overlap in the Lower Yarra. Each of these has a northern, western or south-eastern distribution in Victoria, meeting at Melbourne.

A chorus of several hundred Victorian Smooth Froglets was heard along the drainage line at Wilson Reserve and in a small billabong between the Ivanhoe Golf Course and the river, opposite the Kew Golf Club Billabong on 18 May 1992. They also inhabit damp grass under River Red Gum (billabong) floodplain riparian woodland (16.1) and Swamp

Paperbark swamp scrub (17.1) lining Willsmere Lagoon. The froglet, which is a species of the foothills and ranges, is at its most downstream occurrence in the Yarra system. The froglet is remnant of a mountain fauna that was once widespread along the Lower Yarra (e.g. Superb Lyrebird and Greater Glider occurring as far downstream as Ivanhoe). The population of froglets at Bailey Billabong/Willsmere Lagoon is now disjunct from populations at Westerfolds. This is due to floodplain wetlands of the Lower Yarra being cleared and drained in the middle nineteenth century.

The Spotted Marsh Frog, Common Froglet, Southern Bullfrog and Growling Grass Frog chorus in the billabongs over summer. The Striped Marsh Frog and Southern Brown Tree Frog are less common, while the Verreaux's Tree Frog is found in River Red Gums lining the river.

Freshwater fish

Ed **31^a: Common Galaxias at Bailey Billabong.** Several were present in June 1995. These would have entered during high river floods. It is unknown whether the Australian Smelt survives the competition from alien species including the Mosquito Fish, Roach, European Carp and Goldfish, which are abundant (see Bolin Billabong in site 32). Carp have severely reduced the submerged herbfields and increased the water turbidity. The Short-finned Eel was the only other native species recorded in recent years (January 1991). This species is more tolerant of poor water quality conditions. The Freshwater Blackfish was last recorded in the river at Wilson Reserve in the early 1970s. Redfin are occasionally taken from the river by anglers.

Several rare or threatened native species, including the Tasmanian Mudfish and Spotted Galaxias, likely inhabited the shallow, protected water of the billabongs at the time of settlement. The Yarra Pigmy Perch, which is apparently extinct in the Yarra system, may have also been present. The mudfish and galaxias were both recorded recently downstream of the weir at Dights Falls (see site 29). Competition/predation from alien species and poor water quality would limit and possibly prevent their re-establishment. Water in the sections of Bailey Billabong and Chelsworth Park Swamp is now eutrophic (see site 34) and the substrate contains up to 30 cm of silt.

Butterflies

Ed **31^a: Consimilis Blue.** An adult was recorded at Wilson Reserve in December 1992. Not previously recorded west of the Dandenongs, this species has expanded its range from south-eastern Victoria. The food-plant of the larvae is normally the native Elderberry *Panax*, but apparently in the Lower Yarra they breed on English Ivy.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Partially intact habitat links upstream to Bolin Billabong, downstream to Yarra Bend and along the Darebin Creek to Darebin Parklands.</p>	
<p>Inadequate conservation management in this section of the Yarra will lead to a deterioration in biological values of downstream sites along the Yarra habitat link. There is an inconsistency with regard to conservation and economic rationale behind investing extensive resources into one side of the river or an upstream or downstream section and little into another.</p> <p>Loss of effective habitat links. The river provides a water link but sections of the riparian vegetation are poor quality habitat due to bank erosion and weed invasion. Without long-term conservation works populations of forest birds, streamway mammals and ground fauna such as reptiles will decline as a result of habitat fragmentation and disturbance.</p>	<p>Activities of local conservation groups. The Chelsworth River Parklands Protection League became active in the 1960s. This reformed into the Riverlands Conservation Society. Extensive land protection work, weed control and revegetation of the Bailey Billabong area has been undertaken. The Friends of Wilson Reserve in co-operation with the City of Banyule have undertaken further works over the last two years. Limited financial and labour resources have restricted works to small areas. Indigenous riparian shrub and herbfield species have been successfully planted at Bailey Billabong. Other areas are still heavily weed infested and in need of revegetation.</p> <p>Linkage of urban open space green web parks and the Lower Yarra to the Kinglake Ranges. The site supports River Red Gum floodplain and billabong systems which are poorly reserved in Victoria. The most important conservation priority is to upgrade its conservation management to a comparable level with that conducted upstream in Yarra Valley Park and downstream at Yarra Bend Park. The site forms the habitat link between these two parks. Together, they provide a continuous habitat link from Richmond to Christmas Hills. This in turn links via Watsons Creek to the ranges at Kinglake National Park. This has enabled the return of several species of forest birds.</p>

Regional Hydrological Strategy

Reclamation of floodplain wetlands and loss of farm paddocks to recreation land. There was a large swamp on Irvine's dairy farm below The Boulevard in the area of the Chelsworth Park playing fields (Robin Bailey via Anthea Fleming pers. comm.). This connected to the Chelsworth Park Swamp and extended south to the present Wilson Reserve carpark. The vegetation would have been not unlike Banyule Swamp, dominated by Rush Sedge seasonal wetland. It would have contained channels and lagoons which supported Common Reed seasonal wetland and permanent wetland. The river in flood would have inundated all of this area.

The nature of the swamp on Irvine's dairy farm had changed little in 50 years and it provided habitat for reptiles, frogs and waterbirds. After it was acquired by the City of Heidelberg (1948), the drainage line currently running through Wilson Reserve was put in to drain the swamp and reclaim the land. It then became a municipal rubbish tip and was later developed as sports fields. The Ivanhoe golf course originally occupied land extending to Wilson Reserve. This was prone to inundation and a land swap in the late 1950s secured higher ground where it is presently situated.

Many of the other billabongs were also used as land-fill tips. Extensive areas of the river valley have been reclaimed for playing fields, golf courses and the Eastern Freeway over the last 50 years. The composition of avifauna populations has undergone a major change over this time (see fauna: Chelsworth Park–Wilson Reserve birdlist).

Disturbance to waterbirds. The level of disturbance from human activities is very high. Only a narrow strip of native vegetation screens the river and billabongs from disturbance by humans/dogs. This prevents many of the waterfowl and shy cover-dependent waders from breeding.

Riverbank erosion. This has been most severe on the Ivanhoe side. Human access to fishing and swimming holes has caused large trees and sections of the bank to slump into the river. This was further exacerbated by river de-snagging operations. Altered currents in the river have eliminated the swimming beach on Sandy Point (Wilson Reserve) and the point itself has been cut back 40 m since World War II (Fleming in VORG NOTES 18:2). By the early 1980s the riverbank walking tracks had been severely undercut and the river was getting close to cutting through the bank of Bailey Billabong and the narrow peninsula to the east.

Require wetlands management plan and increased wetland conservation management. The wetlands require a conservation management plan which identifies significant flora/fauna habitat areas, threatening processes and necessary conservation measures. The focus for Bailey Billabong/Chelsworth Park Swamp should be to enhance the conservation values of the marshland flora and waterbird habitat. This area is an integral part of the Lower Yarra wetland and waterbird complex. Increased levels of management at Chelsworth Park Swamp, Willsmere Lagoon and Kew Golf Club Billabong could significantly raise the wetland faunal values of the site.

Redress riverbank erosion. In the early 1980s management by Heidelberg City Council and MMBW was upgraded at Wilson Reserve. This has been partially successful but human disturbance of the riverbank is restricting the establishment of riparian vegetation. Human access where severe erosion has occurred will need to be prevented to allow natural regeneration to occur. Fencing of sensitive and significant areas is needed. Replanting and judicious weed removal will need to be undertaken.

Other Issues

Habitat degradation due to human impact. The current level of management at Wilson Reserve–Bailey Billabong is failing to keep pace with the incremental level of human disturbance and habitat degradation. Weeds including the Madeira Winter-cherry and Blackberry and dense creeper undergrowth of Wandering Jew (*Tradescantia*), Bridal Creeper, Japanese Honeysuckle and Cleavers are prolific along the riverbanks and terraces and at Wilson Reserve. Areas sensitive to erosion or containing significant vegetation are being degraded.

The storm water drain behind Chelsworth Park pavilion at the end of Irvine Road is polluted. The main solid waste components are non-biodegradable plastics (e.g. food and drink containers, plastic bags and styrofoam containers). Accumulated flotsam during floods in Bailey Billabong constitutes a significant threat to waterbirds and fish. These negative landscape elements stimulate antagonistic activities by humans (e.g. rubbish dumping from access along Irvine Road, anglers digging for worms behind the golf course, dogs off leashes etc.) because the area is viewed by some people as wasteland.

Weed control at Wilson Reserve and behind Ivanhoe Municipal Golf Course. Wandering Jew, Madeira Winter-cherry, Bridle Creeper, English Ivy, Japanese Honeysuckle and Cleavers are the priority ground layer weeds to be removed. Hawthorn and willow need to be replaced by native riparian shrubs such as Swamp Paperbark, Woolly Tea-tree, River Bottlebrush, Silver Wattle and Muttonwood. Extensive revegetation works are needed if an improvement of flora and faunal values is to be achieved.

Reduction of water pollution. Retarding/settling ponds and a solid waste trap are needed on the Irvine Road drain which flows into Bailey Billabong and the drain entering Chelsworth Park Swamp. This would reduce the amount of pollutant/solid waste entering the billabongs and Yarra River. Control of solid waste accumulation at Bailey Billabong from river floods needs to be addressed.

Integrated conservation management of the golf courses. Over 50% of the floodplain is golf course. Each fronts onto important habitat along the river or at billabongs. They contain planted ornamental eucalypts and large natural River Red Gums. The River Red Gums provide important nest-sites for hollow nesting birds (particularly parrots) and bats and roosting areas for waterbirds. They also serve as semi-timbered habitat links for birds moving along the Yarra Valley. The importance of the golf courses as native animal habitat should not be underestimated. At night, the low human activity levels of the golf courses provide foraging habitat for waterbirds (e.g. snipe) and owls. An integrated management plan for the golf courses which maximises fauna and habitat values without compromising their recreational utility is viewed as a major conservation priority for the site.

Nature trail and public interpretation facilities. This would improve the visitors' understanding of the fragility and importance of the area and the need for active conservation management.

Site 32 Bolin Billabong

Map Reference:	7922 305178 (Bolin Billabong). One minute lat/long grids include 37°46' x 145°04'.
Location/Size:	Approximately 70 ha.
Municipality:	City of Banyule and City of Manningham (east of the Yarra).
Land Tenure/Use:	Public: Yarra Valley Park (Melbourne Parks & Waterways); and council land such as Boroondara Municipal Public Golf Course (City of Boroondara) and Bulleen Park (City of Manningham). Private: private schools, sporting complexes and the Veneto Club.
Landforms:	Alluvial plain (see YLAP D). Elevation is 7–25 m.

Natural Heritage Values

Landscape. Bolin Billabong is the largest and most intact of the remaining ox-bow lagoons in the Lower Yarra.

Scientific and Educational Values

Rehabilitation and management. Part of the Yarra Valley Park revegetation program.

Public interpretation. Bolin Billabong has been developed as an Aboriginal Heritage interpretation area by Melbourne Parks & Waterways.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: River Red Gum (billabong) floodplain riparian woodland (16.1); Creeping Knotweed–Matted Water Starwort (billabong mudflat) seasonal wetland (25.6)

Relatively intact and extensive stands: Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Partially intact or small stands: River Red Gum (riverbank) floodplain riparian woodland (16.2); River Red Gum (terrace) floodplain riparian woodland (16.3); Blunt Pondweed permanent wetland (26.1); River Red Gum (plains) drainage line woodland (30.1; Koonung Creek)

Remnant, degraded or establishing stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2; eliminated); River Red Gum (alluvial plain) grassy woodland (14.3); Swamp Paperbark swamp scrub (17.1; eliminated); Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1; eliminated)

Rare species: River Swamp Wallaby-grass (TYPE locality at Bolin Billabong)

Critical assemblages or populations: Bolin Billabong on Bulleen Road formed part of an extensive paperbark swamp system at the mouth of the Koonung Creek. The swamp scrub (17.1) is now eliminated but the billabong vegetation (16.1/25.6) at Bolin Billabong and (25.6) at Annulus Billabong is the most intact remaining in GM. Along with the Peron's Tree Frog, the billabong mudflat herbfield may represent a disjunct biogeographic 'raft' from the inland riverine plains. This may have entered southern Victoria through the Kilmore Gap some 6–8000 years ago, during an arid climatic phase. Raft members in the Lower Yarra include the Ferny Azolla, Common Nardoo, Short-fruit Nardoo, Giant Rush, Spotted Duckweed, River Swamp Wallaby-grass, Plains Joyweed, Matted Water Starwort and Small Knotweed.

FAUNAL SIGNIFICANCE: Site 32 Bolin Billabong

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

32^a: 37°45' x 145°04'; Annulus Billabong, Heidelberg

32^b: 37°46' x 145°04'; Bolin Billabong, Bulleen

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 32^b: Glossy Grass Skink

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 32^b: 20 species recorded at Bolin Billabong and Trinity Grammar lake between 13 and 15 January 1991

d. Breeding waterfowl

Local. 32^b: 3 species (Pacific Black Duck, Dusky Moorhen and Eastern Swamphen) at Bolin Billabong on 13 January 1991

f. Breeding migratory insectivores

Local. 32^b: 5 species including the Sacred Kingfisher and Olive-backed Oriole at Bolin Billabong in January 1991

g. Breeding parrots

Regional. 32^b: 5 species including the Little Lorikeet at Bolin Billabong in January 1991

h. Bats

Regional. 32^b: 5 species including the locally rare Large Forest Bat and Chocolate Wattled Bat trapped between 13 and 15 January 1991 at Bolin Billabong

i. Frogs

Regional. 32^b: 7 species including the Striped Marsh Frog between 13 and 15 January 1991 at Bolin Billabong

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 32^b: over 110 species

b. Native birds

Regional. 32^b: over 90 species

c. Native mammals

Regional. 32^b: 9 species

d. Herpetofauna

Regional. 32^b: 12 species

e. Freshwater fish

Regional. 32^b: 2 species at Bolin Billabong (Short-finned Eel and Australian Smelt)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 32^b: 10 species. **32^a:** 7 species

b. Regionally endangered fauna (R1 species)

Regional. 32^a: 1 species. **Birds:** Grey Goshawk

c. Regionally vulnerable fauna (R2 species)

Regional. 32^b: 5 species. **Birds:** Whiskered Tern, Black-winged Stilt, Little Egret. **Reptiles:** Glossy Grass Skink. **Fish:** Australian Smelt

Regional. 32^a: 3 species. **Birds:** Black-tailed Native-hen, Azure Kingfisher. **Frogs:** Peron's Tree Frog

d. Regionally rare fauna (R3 species)

Regional. 32^b: 2 species. **Birds:** Darter. **Reptiles:** Marbled Gecko

Regional. 32^a: 1 species. **Birds:** Red-kneed Dotterel

e. Regionally depleted fauna (R4 species)

Regional. 32^b: 3 species. **Birds:** Buff-banded Rail, Latham's Snipe, Peregrine Falcon

Regional. 32^a: 2 species. **Birds:** Latham's Snipe, Peregrine Falcon

f. Regionally restricted fauna (R5 species)

Regional. 32^b: 13 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Australian Shelduck, Little Eagle, Australian Hobby, Rainbow Lorikeet, Little Lorikeet. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise. **Frogs:** Striped Marsh Frog

Local. 32^a: 2 species. **Birds:** Australian Pelican, Cattle Egret

g. Nesting birds of prey/parrots

Regional. 32^b: Little Lorikeet (3 pair in River Red Gum hollows at Bolin Billabong in January 1991)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory waders

Regional. 32^a: 5 Latham's Snipe at Annulus Billabong on 29 December 1986

c. Waterfowl

Local. 32^b: 24 individuals of 5 species at Bolin Billabong on 13 January 1991

g. Rare/restricted colonial fauna

Regional. 32^b: flocks of 30 to 50 Cattle Egrets and 50 to 70 Australian White Ibis visit the floodplain and playing fields during winter

k. Electrofishing or netting rate

Regional. 32^b: over 20 Australian Smelt were taken from the shallows of Bolin Billabong in October 1984; while this is before the commencement of the 1986–1996 survey period, the record is treated as contemporary since a fish survey has not been conducted since and the species is likely to be still present

Outlook

The faunal significance meets the important Regional Category 1. This should be maintained with ongoing wetland rehabilitation and management programs. With reduced human disturbance more waterbird species and larger numbers (particularly Latham's Snipe) would visit. This would balance any further loss of ground fauna (e.g. Glossy Grass Skink) and forest fauna due to habitat link severance and predation.

FAUNA

Rare or Threatened Fauna

Bc **32^a: Grey Goshawk.** One at Yarra Flats near the Annulus Billabong on 8 July 1994 (Glen Jameson pers. comm.).

Bc **32^b: Glossy Grass Skink.** One located in River Red Gum (plains) drainage line woodland (30.1) along the lower Koonung Creek between the Carey Grammar sports fields and City of Boroondara golf course on 14 January 1991. The skink was under flood debris. The population is very small and isolated from the next nearest on the Plenty River at Yan Yean and on the Yarra at Yering Backswamp. The surrounding floodplain formerly supported Swamp Paperbark swamp scrub (17.1). In the early 1960s, stands of Swamp Paperbark occurred in lagoons later infilled for the City of Camberwell tip (now the golf course) and the Carey sports fields. The paperbarks have been cleared to an intermittent strip along Koonung Creek and a few old plants along the Yarra and at Bolin Billabong. There would have been an extensive stand of paperbark (possibly 20 ha) on the confluence floodplain of the Koonung Creek. Replanting of paperbarks and the development of branch debris above the high water mark of the streams and billabongs will be essential for the conservation of the Glossy Grass Skink.

Other Significant Fauna

Birds

Ec **32^a: Black-tailed Native-hen.** Single bird at the Annulus Billabong on 26 August 1986 (Glen Jameson pers. comm.). Creeping Knotweed–Matted Water Starwort (billabong mudflat) seasonal wetland (25.6) occupies the bare fringes of the Annulus while Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) occupies the deeper water. The wetland becomes dry in late summer–autumn for extensive periods in low rainfall years but remains permanent in years of heavy rain. The two habitats ebb and flow depending on inundation: during dry years, 25.6 resurrects and 25.7 disappears; and the reverse occurs in wet years.

Ec **32^b: Whiskered Tern, Black-winged Stilt and Little Egret.** These are each rare in the Lower Yarra. A few pair of Whiskered Terns were seen at Bolin Billabong and over the Trinity Grammar lake over three successive days in January 1991, possibly nesting locally. The lake has bare edges and mudflats and supports small numbers of waders. A wading Black-winged Stilt was present on 14 January 1991 and single Little Egrets have also been seen on two occasions during late autumn–winter (e.g. 22 June 1988).

Ec **32^a: Azure Kingfisher.** One at Yarra Flats on 9 May 1994 (Glen Jameson pers. comm.).

Ed **32^a: Red-kneed Dotterel.** Single bird at the Annulus Billabong on 8 July 1986 and two at Yarra Flats on 26 August 1986 (Glen Jameson pers. comm.).

Ee **32^b: Buff-banded Rail.** One seen in the grassy (predominantly aliens including Toowoomba Canary-grass, Cocksfoot and Paspalum) enclosed area of Bolin Billabong on 13 January 1991.

Ee **32^{ab}: Latham's Snipe.** Five at the Annulus Billabong on 29 December 1986 (Glen Jameson pers. comm.). Two in Creeping Knotweed–Matted Water Starwort (billabong mudflat) seasonal wetland (25.6) at the inlets on the north-west side of Bolin Billabong on 13 January 1991.

32^b: Waterbirds. Twenty species were observed at Bolin Billabong/Trinity Grammar lake between 13 and 15 January 1991. Only small populations of waterfowl were present as Blunt Pondweed (submerged meadow) permanent wetland (26.1) was not extensively developed. The overflow of the lake runs into a channel between Bolin Billabong and the Veneto Club. Areas of Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) are present along the drainage lines. Giant Rush also occurs in this habitat at the lagoon feeding Trinity Grammar lake and in Annulus Billabong area on the opposite side of the river. It was not extensively searched and additional waterbirds such as crakes and rails might be expected.

32^b: Cormorant and heron roost. Bolin Billabong is a closed oxbow lagoon of the Yarra River lined with old River Red Gums and replanted shrublands. Remnant Tree Violets and Swamp Paperbarks are present. The trees provide nest sites for a number of bird species (e.g. White-faced Heron) and roosting areas for others (e.g. cormorants, particularly the Little Black Cormorant). As dense shrublands develop under the large red gums and the central section of the billabong is closed to the public, a breeding colony of Little Black Cormorants could form. Darters are occasionally seen. One of these was an immature with a 'coppery neck' (Glen Jameson pers. comm.). Two others were single adults in 1992. Flocks of up to 50 Cattle Egrets are seen during winter on the surrounding playing fields.

32^b: Tree hollow species—parrots. Five species were recorded nesting in River Red Gum floodplain riparian woodland (16.1) at Bolin Billabong in January 1991. Three pair of Little Lorikeets were nesting in the old River Red Gums around the billabong.

Mammals

32^b: Tree hollow species—bats. Five species including the Large Forest Bat and Chocolate Wattled Bat were trapped in River Red Gum floodplain riparian woodland (16.1) at Bolin Billabong in January 1991. These two bat species which are common upstream on the Yarra have not been recorded downstream. The bat trap was placed on the walking track at the west end under an overhanging limb of a River Red Gum.

Reptiles

Ed **32^b: Marbled Gecko.** One located under loose bark of a River Red Gum (floodplain riparian woodland; 16.1) at Bolin Billabong in January 1991.

Frogs

Ec 32^a: Peron's Tree Frog. They inhabit River Red Gum-lined billabongs and floodplain wetlands containing Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) in the Lower Yarra. They were heard calling in the Annulus Billabong area on 23 January 1989.

Freshwater fish

Ec 32^b: Australian Smelt. This species was recorded at Bolin Billabong in October 1984 (Raadik in prep.). Over 20 individuals were taken. They were sheltering under fallen River Red Gum leaves in the shallows of the billabong. The sample was dominated by alien fish (e.g. Mosquito Fish, Weather Loach and Goldfish). Australian Smelt were recorded in only two of the 52 electrofishing sites in NEM (each a small population) but they are relatively common in the Yarra River between Templestowe and Warrandyte (see site 57). The species is widespread and relatively common in southern Victorian streams but appears to be localised in the Yarra system.

Australian Grayling. Keartland (1900) reports that the Australian Grayling was a popular sporting fish at Templestowe in the nineteenth century. There is a pre-1900 record of grayling taken from 'Laidlaws', the property containing Bolin Billabong (Raadik in prep.). With the building of a permanent weir at Dights Falls, this migratory species was prevented from moving upstream to breed in the rapids and sandy substrates of the Yarra between Heidelberg and Yarra Glen. With construction of a fish-way at Dights Falls, the grayling has reappeared in the Middle Yarra (site 57). Habitat deterioration and competition from introduced species, particularly Brown Trout, may prevent their population recovery. The most recent records of the Flat-headed Gudgeon and Common Galaxias from this section of the Yarra were from March 1905. Both are likely still present.

Historical accounts of fauna

Boroondara. There is little documentation of the fauna of the paperbark scrub and River Red Gum plains of the inner eastern suburbs of Melbourne. Swamp Paperbark occurs throughout the Gippsland Coastal Plains to the south-east and the Yarra River system forms its western limit in range. There are species that have been eliminated in the last 30 years such as the Echidna and reptiles and ones that went earlier this century such as the Koala, Eastern Grey Kangaroo, Black Wallaby and Common Wombat. Some species would have been eliminated early after settlement. These have now become rare throughout their range in Victoria. Gleanings from natural history accounts from the Gippsland Coastal Plains (e.g. Wheelwright 1862, Norris *et al.* 1983 and Andrew *et al.* 1984) provide some clues.

The paperbark swamps of the floodplain would have supported the Long-nosed Bandicoot (extinct in the Lower Yarra) and probably the Southern Brown Bandicoot (known from only Kinglake NP in NEM) and possibly the Common Long-nosed Potoroo (extinct in GM). Both bandicoots co-exist in the paperbark swamps of the Upper Yarra at Wooriyallock and Yellingbo. The rare Swamp Skink probably also lived in the paperbark scrub along with the Glossy Grass Skink and the bandicoots, as it does along the Cockatoo Creek in the Upper Yarra. The Swamp Skink was formerly present nearer Melbourne in the paperbark swamps of the Dandenong Creek at Bayswater.

The reed and spike-sedge billabongs and fringing paperbark would have been the habitat of the Brolga and Magpie Goose. The Cape Barren Goose would have been a winter visitor from the Bass Strait islands. Several rare or threatened species of fish would have likely bred in the shallow, protected water of the paperbark swamps and the gravel riffles of the river and lower sections of its tributaries such as Koonung Creek. These include the Pouched Lamprey, Tasmanian Mudfish, Spotted Galaxias, Yarra Pigmy Perch and Australian Grayling.

One can only surmise that the Black Sheoke and Tree Banksia of the sandstone hill-crests and colluvial plain-slopes would have been a feeding area for the Superb Parrot and Bush Stone-curlew (both breeding residents along the river at Heidelberg; Keartland 1900) and the Grey-crowned Babbler. The Superb Parrot nested in the large River Red Gum hollows and possibly survived until the 1940s (see site 30). They are now extinct in southern Victoria. They feed on seeds and Black Sheoke probably was an important food source. The Red-tailed Black-Cockatoo whose distribution and food preference is linked with sheoke woodlands, was possibly present (see site 80). This may well be the species referred to by Wheelwright (1862) as 'being occasionally seen at Frankston and not uncommon in the scrubs of Port Phillip Heads'.

The Bush Stone-curlew is now near extinction in southern Victoria and threatened with extinction in northern Victoria by clearing of grassy woodland habitat and fox predation. This species often nests amongst fallen branches under groves of sheoke. The Grey-crowned Babbler, which persisted in the Yarra Valley near Lilydale until the 1940s, would have also been

present. The groves of sheoke, Golden Wattle, Tree Banksia and Cherry Ballart under the open woodland would have formed ideal habitat. The Peaceful Dove would have also visited these shrublands. The Red-necked Wallaby and an extinct species of bettong may have also inhabited the scrubby swamp and hill country at the time of settlement.

MANAGEMENT

Regional Habitat Link Strategy

(see Site 33)

Habitat connectivity. Partially intact habitat links upstream to Banyule Flats and downstream to Bailey Billabong. Ineffective link along the Koonung Creek.

Site 33 Banyule Flats–Warringal Swamplands

Map Reference:	7922 313201 (Banyule Swamp); 7922 318200 (Banyule Billabong). One minute lat/long grids include 37°44' x 145°05' and 37°45' x 145°04' to 145°05'.
Location/Size:	Approximately 180 ha.
Municipality:	City of Banyule (major part; north of the Yarra) and City of Manningham (south of the Yarra).
Land Tenure/Use:	Public: Banksia Park, Banyule Flats Billabong and the Yarra River are in Yarra Valley Park (Melbourne Parks & Waterways), the remainder of Banyule Flats including Banyule Swamp and Warringal Swamplands are owned by the City of Banyule. Private: floodplain paddocks, playing fields, commercial areas near Banksia Park and adjoining residential areas.
Landforms:	Alluvial plain (see YLAP D). Elevation is 8–40 m.

Natural Heritage Values

Landscape. Lowland riverine floodplains are amongst the most threatened landscapes in Victoria. Banyule Swamp is the most intact and biologically significant shallow freshwater marsh in the Lower Yarra.

Scientific and Educational Values

Rehabilitation and management. Restoration of Warringal Swamplands from the late 1970s by the City of Heidelberg (Banyule) and the Warringal Conservation Society represents the first major revegetation project along the Yarra. Similar works have commenced at Banyule Flats. Revegetation programs by Melbourne Parks & Waterways have been undertaken in adjoining sections of Yarra Valley Park (e.g. Banksia Park and Banyule Billabong). Warringal Conservation Society has been involved with the management of Banyule Flats and Warringal Swamplands for many years. Banyule Flats should be given priority for further rehabilitation and management works (see Conservation Measures).

Public interpretation. Already an important recreation area, the site has very high potential for public appreciation of and education about wetland fauna (particularly waterbird viewing) and faunal habitat values. The Main Yarra Trail bike path and extensive nature trail systems have been established.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1; Banyule Swamp); Blunt Pondweed–Pacific Azolla permanent wetland (26.1; Banyule Swamp)

Relatively intact and extensive stands: River Red Gum (billabong) floodplain riparian woodland (16.1); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Partially intact or small stands: River Red Gum (alluvial plain) grassy woodland (14.3); River Red Gum (riverbank) floodplain riparian woodland (16.2); River Red Gum (terrace) floodplain riparian woodland (16.3); Creeping Knotweed–Matted Water Starwort (billabong mudflat) seasonal wetland (25.6); River Red Gum (plains) drainage line woodland (30.1; Banyule Creek)

Remnant, degraded or establishing stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Long-leaf Box–Manna Gum escarpment woodland (13.1); Swamp Paperbark swamp scrub (17.1)

Vulnerable species: Spotted Duckweed (Banyule Swamp)

Rare species: River Swamp Wallaby-grass (Banyule Billabong)

Critical assemblages or populations: Banyule Swamp contains the largest and most diverse and intact stands of seasonal wetland (25.1) and permanent wetland (26.1) in the Lower Yarra. Banyule Flats is the most significant freshwater wetland area in the Lower Yarra. Seasonal and permanent wetland at Banyule Swamp and the fringing River Red Gums, emergent and mudflat herbfields and open water of Banyule Billabong are key wetland areas in maintaining the viability of populations of waterbirds and wetland ecosystems in the Lower Yarra.

FAUNAL SIGNIFICANCE: Site 33 Banyule Flats–Warringal Swamplands

Assessment: State—Category 2 (B, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

33^a: 37°44' x 145°05'; Creek Bend Reserve

33^b: 37°45' x 145°04'; Banksia Park/Warringal Swamplands

33^c: 37°45' x 145°05'; Banyule Flats–Banyule Swamp/Billabong

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 33^c: Baillon's Crake, Australasian Bittern, Grey Goshawk, Powerful Owl

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 33^c: 27 species on 28 December 1991 and 23 species on 3 April 1992 at Banyule Billabong/Banyule Swamp

f. Breeding migratory insectivores

Regional. 33^c: 10 species at Banyule Billabong on 28 December 1991

h. Bats

Regional. 33^c: 4 species trapped at Banyule Billabong on 28 December 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 33^c: 153 species

b. Native birds

State. 33^c: 125 species

c. Native mammals

Regional. 33^c: 11 species

d. Herpetofauna

Regional. 33^c: 17 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 33^c: 21 species

b. Regionally endangered fauna (R1 species)

Regional. 33^c: 1 species. **Birds**: Grey Goshawk

c. Regionally vulnerable fauna (R2 species)

State. 33^c: 6 species. **Birds**: Baillon's Crake, Black-winged Stilt, Little Egret, Australasian Bittern, Blue-winged Parrot.
Frogs: Peron's Tree Frog

d. Regionally rare fauna (R3 species)

State. 33^c: 8 species. **Birds**: Australian Spotted Crake, Darter, Red-kneed Dotterel, Australasian Shoveler, Hardhead, Pink-eared Duck, White-browed Woodswallow. **Reptiles**: Broad-shelled Tortoise

e. Regionally depleted fauna (R4 species)

Regional. 33^c: 6 species. **Birds**: Brown Quail, Buff-banded Rail, Latham's Snipe, Swamp Harrier, White-winged Triller, Rufous Songlark

f. Regionally restricted fauna (R5 species)

Regional. 33^c: 15 species. **Birds:** Australian Pelican, Nankeen Night Heron, Great Egret, Cattle Egret, Royal Spoonbill, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Brown Songlark. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

State. 33^c: 30 Latham's Snipe at Banyule Swamp on 30 December 1994 (up to 50 recorded in recent years); 12 were also recorded on 28 December 1991

f. Frogs

Regional. 33^c: over 100 of three species excluding the Spotted Marsh Frog and Common Froglet in December 1991 including one the largest choruses of Growling Grass Frogs heard in NEM

l. Regionally vulnerable fauna (R2 species)

Regional. 33^c: 10 Blue-winged Parrots feeding around the edge of Banyule Swamp and Banyule Billabong on 3 April 1992

Outlook

Habitat enhancement works should consolidate the faunal significance in State Category 2, particularly for breeding waterfowl and cover-dependent waterbirds such as Latham's Snipe and crakes. Enhancement of wetland habitats at Banyule Flats has improved the viability of populations of waterbirds and wetland ecosystems in the Lower Yarra. Widespread and extensive loss of wetland habitat has depleted wetland biota throughout the Yarra system.

FAUNA

Rare or Threatened Fauna

Bc **33^c: Baillon's Crake.** One observed in Blunt Pondweed–Pacific Azolla permanent wetland (26.1) at the south end of Banyule Swamp on the evening of 28 December 1991.

Bc **33^c: Australasian Bittern.** One heard calling at dusk from Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) at Banyule Swamp on 28 December 1991.

Bc **33^c: Grey Goshawk.** Bird in white plumage phase recorded in River Red Gum (billabong) floodplain riparian woodland (16.1) at Banyule Flats Billabong in March 1990 (Richard Loyn pers. comm.). Birds were recorded breeding upstream in Yarra Valley Park (site 57) in December 1994. Other nearby sightings at Janefield in the Plenty Gorge and La Trobe University suggest that autumn dispersal of young birds occurs along the Plenty River and Yarra River.

Bc **33^c: Powerful Owl.** Recorded in River Red Gum (billabong) floodplain riparian woodland (16.1) at Banyule Flats on 21 February 1995 (Glen Jameson pers. comm.).

Critical Assemblages or Populations

Db **33^c: High diversity of birds.** Banyule Swamp and Banyule Billabong support the highest avifauna diversity in the Lower Yarra. Forty-three species of waterbirds were observed at Banyule Flats in the 1986-96 survey period. This is the most diverse assemblage recorded along the Yarra in NEM.

Fa **33^c: High population density of Latham's Snipe at Banyule Swamp.** Thirty were recorded on 30 December 1994. Up to 50 snipe have been recorded at the swamp during systematic counts for the national snipe surveys in the early to mid-1980s (Anthea Fleming pers. comm.). A dozen had been recorded on 28 December 1991.

Other Significant Fauna

Birds

Ec **33^c: Black-winged Stilt and Little Egret.** Banyule Swamp was flooded after the heavy rains of Christmas 1991. Two stilts were observed wading in Blunt Pondweed–Pacific Azolla permanent wetland (26.1) at the south end on

the evening of 28 December 1991. A single Little Egret was present on the shoreline of Banyule Billabong on 3 April 1992.

- Ec* **33^c: Blue-winged Parrot at Banyule Flats.** Ten were flushed from the grasslands surrounding the swamp and billabong on 3 April 1992. On close investigation the birds were found to be eating the seeds of Summer Grass (*Digitaria*), Spear Thistle and probably Prostrate Knotweed which was also present.
- Ed* **33^c: Red-kneed Dotterel at Banyule Billabong.** A pair of Red-kneed Dotterel was present along with a pair of Black-fronted Dotterel on the shingle shores at the west end of the billabong on 28 December 1991.
- Ed* **33^c: Australasian Shoveler, Hardhead and Pink-eared Duck.** A shoveler and two Hardhead were present at Banyule Swamp on 28 December 1991 and a pair of Pink-eared Ducks was present at Banyule Billabong on 3 April 1992. The Australian Shelduck has also been observed. Each of these waterfowl are rarely seen at La Trobe University, Bolin Billabong or elsewhere in the Lower Yarra.
- Ee* **33^c: Brown Quail, Buff-banded Rail and Swamp Harrier at Banyule Swamp.** A Buff-banded Rail was present in Rush Sedge–Common Spike-sedge–Austral Rush seasonal wetland (25.1) on 28 December 1991. Several Brown Quail (later found to be breeding) were heard calling at dusk on 28 December. The harrier was seen over the swamp on 3 April 1992.

Reptiles

- Ed* **33^c: Broad-shelled Tortoise at Banyule Billabong.** One was sunning amongst Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) on the bank at the eastern end of the billabong on 3 April 1992. Broad-shelled Tortoise populations in the Yarra River derive from escapees. The natural distribution of the species in Victoria is in the Murray basin, where it is considered vulnerable.

Freshwater fish

33^c: Banyule Billabong. Freshwater Blackfish and Flat-headed Gudgeon were taken from the billabong in a fish survey in 1972 (Raadik in prep.). The provision of additional hollow submerged logs would be beneficial (if blackfish still persist). With these works in conjunction with the extensive revegetation being undertaken, the blackfish might be reintroduced. It is not feasible to remove the alien Mosquito Fish, Goldfish and European Carp as these are throughout the Lower Yarra and would re-enter the billabong when the river floods. Several rare species including the Yarra Pigmy Perch and Dwarf Galaxias could potentially be introduced into Banyule Swamp (where Mosquito Fish have not been seen). The alien fish are the main reason why pelicans and cormorants visit the billabong.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Riparian habitat links occur upstream along the Yarra to the Bonds Road–Birraring Park–Westerfolds Park and Plenty River Flats sites and downstream to the Bolin Billabong and Bailey Billabong sites. A narrow strip of native vegetation fronts the river and billabongs but much of the understorey is heavily weed invaded. Partial links along the Banyule Creek connect the Simpson Barracks site. The site contains the most downstream regular occurrences along the Yarra River of many forest bird species and terrestrial mammals (e.g. Echidna and Eastern Grey Kangaroo). This can be attributed to a functional habitat link upstream along the Yarra River and the provision and management of an extensive area at Banyule Flats in a biological reserve.</p> <p>Habitat Potential. The habitat potential of Banyule Flats Reserve, which has been public parkland for only a few years, is second to none in (inner) Melbourne, providing there are no further urban or intensive recreational excisions (Birds of Heidelberg and the Yarra Valley, Warringal Conservation Society, 1981). It requires careful management to repair damage incurred from intensive pastoral land-use.</p>	
<p>Constriction of habitat links. The habitat link from Westerfolds constricts downstream of Banyule Flats. The riparian vegetation band narrows and urban development lies along sections of the river valley. Major road crossings downstream (e.g. Banksia Street) would provide a significant barrier to movement of ground fauna. Mammals including the Echidna, Eastern Grey Kangaroo, Koala and Wombat, which have re-established at Westerfolds Park, are unlikely to extend beyond Banksia Street.</p>	<p>Strengthen habitat links. Further development of wetland and grassy woodland vegetation will be required to maintain the present fauna populations and strengthen the utility of the site as the innermost viable habitat/fauna node along the Yarra River system. Stands need to be of adequate size and width to support resident populations of shrubland species such as the Superb Fairy-wren, Willy Wagtail, Red-browed Finch, Yellow-rumped Thornbill and White-browed Scrubwren. Thickets at Banyule Flats are used as wintering sites by small numbers of White-fronted Chats, Golden Whistlers and Flame Robins.</p> <p>Priority works for both private and public land should be to restore significant remnant bushland and augment the Yarra River habitat link. From a biological and aesthetic viewpoint the site is the wedge between urban development downstream and the open spaces of Templestowe and Lower Plenty upstream. It is a vital part of the Yarra River corridor and its protection and development should be the primary focus of the Regional Habitat Link Strategy for the City of Banyule.</p>

Red gum dieback due to insect damage and loss of foliage birds. There is severe dieback caused by psyllids occurring on River Red Gums, Blakely's Red Gums, Swamp Gums and Yellow Box at Creek Bend Reserve. Effective control of these pests has been lost as species of beneficial foliage insectivores (e.g. Spotted Pardalote and Golden Whistler) have declined. This has been caused by fragmentation and degradation of the streamway habitat by past farming and present residential development.

Bushland occupation by aggressive, urban open space birds. Species such as the Noisy Miner, Common Myna, Spotted Turtle-Dove, Common Blackbird, House Sparrow and Common Starling have become dominant in the linear strips or small stands of native woodland vegetation in the site.

Revegetation along Banyule Creek to Simpson Barracks and dieback control. Banyule Creek rises in Simpson Army Barracks. A revegetation plan should be formulated to link the barracks woodland to the Yarra. Open areas along the creek should be replanted with native eucalypts and wattles to create a wider habitat link. Stands of River Red Gum and Blakely's Red Gum are undergoing advancing dieback. To reverse this requires weed control, cessation of slashing of saplings and grassland containing stands of Kangaroo Grass and Weeping Grass and replanting of dense understorey shrubs such as Blackwood and Golden Wattle. The wattles may be crucial in attracting shrub layer birds which control the insects that cause defoliation of the eucalypts.

Regional Hydrological Strategy

Wetland habitat loss through farming/urban development. Soon after settlement the paperbarks were cleared and the lower section of Banyule Creek was diverted to the west of Banyule Swamp to reclaim land. This area was grazed by livestock and cropped for cereals and potatoes in dry years. Cattle were turned into the southern section of the swamp in summer to feed on waterplants. Farming over 140 years degraded the wetland. In recent decades areas of swampland to the north and east of Banyule Swamp were infilled for sports fields. Housing now surrounds it on the hills.

Pollution and degradation of Banyule Creek. The water is fed by polluted urban runoff and the creek is overgrown with weeds, promoted by nutrient enrichment. It has low biological and aesthetic values and appears and functions as a drain.

Rehabilitation of Banyule Swamp and the adjoining section of Banyule Creek. The original hydrological pattern of lower Banyule Creek and Banyule Swamp should be restored. The feasibility of diverting the creek upstream of the swamp through a series of filtration ponds should be explored. This would assist in settling the oil and other suspended material and purifying the water. A hard-rubbish trap would be beneficial. The ponds would create bodies of permanent water which would attract a greater diversity and abundance of waterbirds over a longer period of the year.

Screening and habitat planting, barriers and revegetation zones at Banyule Swamp. Wetland values would increase under management including enrichment planting with herbfield species and shrubs such as Swamp Paperbark. Shrubland has been established to screen sections of Banyule Swamp. Additional thickets (e.g. Tree Violet, Tree Bursaria and Blackwood) on the fringing rises of the swamp would provide valuable foraging habitat and cover for foliage birds and roosts for waterbirds and birds of prey. A shrub shelterbelt of Swamp Paperbark above the high water mark at the south end is required to screen the swamp from the Main Yarra Trail. Planting trees and shrubs should control the Chilean Needle-grass around the swamp. A barrier around the perimeter of the swamp may be needed to restrain humans and their dogs from approaching the swamp. Revegetation areas should be closed to public access.

Banyule Billabong habitat works. Extensive restoration works and indigenous plantings have been undertaken. The billabong supports a high diversity of waterbirds. As habitat develops additional species will be attracted. The eastern end contains extensive areas of submerged and emergent herbfield vegetation. This provides secluded habitat for cover-dependent waterbirds such as crakes and rails and feeding areas for waterfowl. Cattle grazing should be excluded from freshwater meadows inside the horseshoe on the south side of the billabong. Revegetation works have been conducted in this area. As this habitat re-establishes it would support additional Latham's Snipe.

The public should be excluded from entering the east end of the billabong where many of the waterbirds roost. Ample viewing points to the billabong exist from the Main Yarra Trail along the north side. A marked nature trail and trail guide should be set up. Swamp Paperbark should be planted at the high water mark and ground habitat such as logs and branch debris (e.g. Hawthorn removed from the escarpments) should be developed for reptiles and frogs.

Provision of more waterbird roosting habitat at Banyule Billabong. The western end of the billabong contains deeper open water. The shingle and silt shorelines and mudflats and submerged mudbars provide wader habitat. There are not enough bird roost sites over the water. Dead trees should be provided.

Other Issues

Weeds and livestock grazing. Livestock grazing over many years has damaged the banks of Banyule Billabong and the adjacent Yarra River. Native grassland areas on the escarpments have been cleared of overstorey, apart from scattered eucalypts, wattles and Sweet Bursaria. They have been invaded by grassy and woody weeds. Blackberry, Chilean Needle-grass and a host of other threatening herbaceous weeds are present around Banyule Swamp and along Banyule Creek. The ground has been stripped of logs and natural debris.

Uncontrolled human access into important areas for waterbird conservation and revegetation works at Banyule Flats is a problem.

Weed control at Banyule Swamp. The weeds should be removed (particularly Chilean Needle-grass) and the weedy fringe replanted with native herb species such as Common Tussock-grass. Regeneration of River Red Gums needs to be encouraged.

Creek focus for revegetation works—Friends of Banyule Creek group. The lower Banyule Creek is degraded and weed-dominated. With planning and works the habitat and water quality could be improved markedly. A Friends of Banyule Creek group is needed to provide a focus for public involvement and awareness (e.g. the value of indigenous plants in gardens)..

Conservation and recreational use management plan. A conservation management plan should be prepared.

Bird hide, interpretation centre and nature trail/guide. Excellent viewing points are available around Banyule Swamp but these are too open and birds are frightened away when people move along the walking tracks. Unrestrained dogs scatter the snipe, ducks and large waders on the swamp. A bird hide and interpretations hut could be erected amongst a planting on the rise near the pathways at the south end of the swamp. With some thought to location it might be placed in a spot which also gives viewing access to the billabong.

Reintroduction of missing ground fauna. With adequate habitat works and predator control, rare lizard and mammal species such as the Glossy Grass Skink, Swamp Skink and Swamp Rat of the paperbark scrub of the Yarra Alluvial Plains could be re-introduced.

YLAP E YARRA RIVER PLENTY RIVER TO DIAMOND CREEK

This management unit consists of one site of state faunal significance (site 35) and one of regional faunal significance (site 34) and surrounding land that forms habitat links.

Map Reference: 7922 324202 to 7922 370217 (Yarra River).

Location/Size: Yarra River valley from the Plenty River to 500 m upstream of Diamond Creek. Approximately 550 ha.

Municipality: Shire of Nillumbik and City of Manningham (south of Yarra).

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands. It contains undulating hills and plain-slopes to both sides of the Yarra River. The Yarra has formed an extensive floodplain.

Landforms

Foothill: hill-crests, hill-slopes, river escarpments and drainage lines. Alluvial plain: plain-slopes, sand-plain, river valley, alluvial floodplain, terraces, billabongs and artificial floodplain wetlands. Elevation is 10–60 m.

Hydrology

The Yarra River is a large, perennial stream with sections of faster-moving rapids and slow-flowing deep water pools (to 8 m depth) on the convex side of bends with sandbars lined with reeds on the concave side of the river. The Yarra in this section is a mature stream. Montpelier Billabong lies at the upstream end of an extensive closed oxbow lagoon system of the old watercourse.

There are two perennial tributaries entering from the north, the Plenty River and Diamond Creek. The lower section of the Plenty is similar (on a smaller scale) to the Yarra. Diamond Creek has the character of a foothills stream and contains slow-moving, open water pools of about 2 m depth and sections of faster-moving rocky/sandy rapids. The pools contain submerged logs, emergent snags and mudbars. Ruffy Creek, which enters from the south at Templestowe, is now a perennial stream fed by urban runoff in the summer months. The Plenty enters the Yarra through broad alluvial flats. Below the confluence of the Plenty River the Yarra floodplain becomes more extensive and is prone to inundation.

Rainfall: 660–680 mm.

Site 34 Bonds Road–Birrarrung Park–Westerfolds Park

Map Reference:	7922 324202 to 7922 356212 (Yarra River from the mouth of the Plenty River to the Fitzsimons Road bridge). One minute lat/long grids include 37°44' x 145°07' and 37°45' x 145°05' to 145°07'.
Location/Size:	Approximately 390 ha.
Municipality:	City of Banyule and City of Manningham (south of Yarra).
Land Tenure/Use:	Public: Birrarrung Park, Westerfolds Park, the river flats at the south end of Bonds Road and the Yarra River are part of Yarra Valley Park (Melbourne Parks & Waterways). Montpelier Reserve (City of Banyule). Finns Reserve Lower Templestowe (City of Manningham). Private: Odyssey House (Blessed Sacrament Fathers). Amberley (Christian Brothers). Paddocks on the Yarra/Plenty River flats south of Cleveland Avenue at Lower Plenty and house and bush blocks fronting the Yarra at Lower Templestowe and Lower Plenty. Sections of the Bonds Road flats in Yarra Valley Park are grazed by cattle and horses. The remainder of the park is managed for conservation.
Landforms:	Foothill and alluvial plain (see YLAP E). Elevation is 10–55 m.

Natural Heritage Values

Landscape. The belt of River Red Gum (alluvial plains) grassy woodland at Westerfolds Park and downstream at Bonds Road near Cleveland Avenue is the most extensive of few remaining areas of this landscape along the Yarra River. The site is one of the last intact meeting points (the remainder are under the eastern suburbs) in Melbourne of the foothills and alluvial plains.

Scientific and Educational Values

Rehabilitation and management. The source of the following information is Parks & Waterways (1996). One of the most extensive revegetation and rehabilitation programs conducted in GM has been undertaken in Yarra Valley Park. In 1990, some 50 000 trees and shrubs were planted. Westerfolds Park is 123 ha, 33% of which is revegetation area. Planting has been incorporated into broader environmental interpretation programs. Since 1993 approximately 21 000 trees, shrubs and herbs have been planted by groups including the Friends of Yarra Valley Parks, primary, secondary and disabled schools, scouts, Skillshare, LandCare (community based land protection program coordinated by the Department of Natural Resources and Environment) and the Environment Action Program for the unemployed (LEAP). The friends group formed in 1991 to assist with labour intensive works such as tree planting and weed removal. Since 1993 a volunteer propagation group associated with the Friends of Yarra Valley Parks has been involved in planting, seed collection and development of the Friends Nursery. Species have covered a broad range of ecotypes from forest, woodland, grassland to wetland. In 1994–95 the Friends Nursery produced more than 20 000 plants that were planted across Yarra Valley Parklands in 1995. This expanded to more than 35 000 plants in 1995–96. Revegetation areas at Westerfolds have become important for many species of birds including the Powerful Owl and Latham's Snipe.

Public interpretation. Westerfolds Park is a high profile public open space and recreation area and outdoor education centre on natural heritage. It hosted 470 000 visitors in 1995 and provides over 6 km of multi-purpose bitumen trails and picnic and recreational activities such as horse trails and canoe ramps. Westerfolds is the major environmental education and activity centre of Yarra Valley Park. For example, the venue of the annual Envirofest activities, a festival demonstrating environmentally friendly activities and products, attracted 10 000 people in 1995. State of the art environmental programs are being undertaken at Westerfolds Park and the area offers a unique experience for the public.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: River Red Gum (riverbank) floodplain riparian woodland (16.2; Westerfolds downstream of Main Yarra Trail bridge)

Relatively intact and extensive stands: Muttonwood riparian scrub (18.1); River Red Gum (plains) drainage line woodland (30.1)

Partially intact or small stands: Manna Gum (riverbank) riparian forest (5.1); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Long-leaf Box–Manna Gum escarpment woodland (13.1); River Red Gum (alluvial plain) grassy woodland (14.3); Hill Manna Gum sand-plain woodland (15.1); River Red Gum (billabong) floodplain riparian woodland (16.1); River Red Gum (terrace) floodplain riparian woodland (16.3); Rush Sedge–Common Spike-sedge seasonal wetland (25.1); Tall Sedge–Soft Bog-sedge seasonal wetland (25.4); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Remnant, degraded or establishing stands: Manna Gum (terrace) riparian forest (5.2); Swamp Gum gully woodland (10.3); Yellow Box escarpment woodland (13.2); Blakely’s Red Gum grassy woodland (14.5); Yellow Box–Candlebark grassy woodland (14.6); Golden Wattle cliff/escarpment shrubland (20.4); Blunt Pondweed permanent wetland (26.1)

Vulnerable species: Matted Flax-lily

Rare species: Stream Club-sedge, River Swamp Wallaby-grass, Short Water Starwort, Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Floodplain Riparian Woodland Critical Conservation Area. Strategic Habitat Link.

FAUNAL SIGNIFICANCE: Site 34 Bonds Road–Birrarrung Park–Westerfolds Park

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

34^a: 37°44' x 145°07'; Westerfolds Park/Montpelier Island–Billabong

34^b: 37°45' x 145°05'; Birrarrung Park

34^c: 37°45' x 145°06'; Bonds Road/Finns Reserve

34^d: 37°45' x 145°07'; south-west corner of Westerfolds Park

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 34^a: Swift Parrot recorded in 1986

c. Rare fauna

Regional. 34^c: Baillon’s Crake, Little Bittern,

Regional. 34^a: Lewin’s Rail, Black Falcon, Large-footed Myotis

Regional. 34^b: Australasian Bittern, Black Falcon

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 34^a: 5 species trapped at Westerfolds in the bed of Dry Creek near the Yarra River at Horseshoe Bend on 26 January 1990

i. Frogs

Regional. 34^a: 8 species calling after rain in the west section of Westerfolds on 5 February 1990

m. Freshwater fish

Regional. 34^c: 2 species (Common Galaxias and Australian Smelt in August 1991)

Regional. 34^a: 2 species (Short-finned Eel and Macquarie Perch in February 1985)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 34^a: 149 species. **34^c:** over 100 species between Cleveland Avenue and Finns Reserve

b. Native birds

Regional. 34^a: 113 species. **34^b:** over 90 species. **34^c:** over 80 species

c. Native mammals

Regional. 34^a: 17 species. **34^c:** 10 species

d. Herpetofauna

Regional. 34^a: 19 species. **34^c:** 15 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 34^a: 20 species. **34^c:** 15 species

Local. 34^b: 9 species

b. Regionally endangered fauna (R1 species)

Regional. 34^b: 1 species. **Birds:** Intermediate Egret

c. Regionally vulnerable fauna (R2 species)

Regional. 34^a: 5 species. **Birds:** Lewin's Rail, Black Falcon, Black-eared Cuckoo. **Mammals:** Large-footed Myotis.
Frogs: Peron's Tree Frog

Regional. 34^c: 5 species. **Birds:** Baillon's Crake, Black-winged Stilt, Little Bittern. **Frogs:** Peron's Tree Frog. **Fish:**
Australian Smelt

Regional. 34^b: 2 species. **Birds:** Australasian Bittern, Black Falcon

d. Regionally rare fauna (R3 species)

Regional. 34^a: 7 species. **Birds:** Darter, Little Corella, Fork-tailed Swift. **Reptiles:** Murray River Tortoise, Gippsland
Water Dragon. **Fish:** Freshwater Catfish, Macquarie Perch

Regional. 34^b: 3 species. **Birds:** Darter, Hardhead, Musk Duck

Regional. 34^c: 2 species. **Birds:** White-browed Woodswallow. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 34^a: 8 species. **Birds:** Buff-banded Rail, Latham's Snipe, Peregrine Falcon, Powerful Owl, Australian King-
Parrot, Swift Parrot, Bassian Thrush. **Frogs:** Bibron's Toadlet

Regional. 34^c: 8 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Rainbow Bee-eater, White-winged
Triller, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

Regional. 34^b: 3 species. **Birds:** Latham's Snipe, Peregrine Falcon, Rufous Songlark

f. Regionally restricted fauna (R5 species)

Regional. 34^a: 17 species. **Birds:** Brush Bronzewing, Great Egret, Cattle Egret, Australian Shelduck, Little Eagle,
Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, Olive Whistler, Spiny-cheeked
Honeyeater. **Mammals:** Koala. **Reptiles:** Delicate Skink, Tussock Skink. **Frogs:** Common Spadefoot Toad,
Striped Marsh Frog

Regional. 34^c: 10 species. **Birds:** Cattle Egret, Nankeen Night Heron, Australian Hobby, Barn Owl, Rainbow Lorikeet,
Long-billed Corella. **Mammals:** Water Rat. **Reptiles:** Delicate Skink, Tussock Skink. **Frogs:** Common Spadefoot
Toad

Regional. 34^b: 8 species. **Birds:** Australian Pelican, Great Egret, Cattle Egret, Nankeen Night Heron, Royal Spoonbill, Australian Shelduck, Australian Hobby, Barn Owl

g. Nesting birds of prey/parrots

Regional. 34^a: Little Lorikeet: River Red Gum hollow at Westerfolds in January 1990

Regional. 34^c: Rainbow Lorikeet and Long-billed Corella: River Red Gum hollows south of Cleveland Avenue in December 1990

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory waders

Regional. 34^a: 6 Latham's Snipe on the mudflats of Montpelier Billabong and the banks of the adjacent section of the Yarra on 2 December 1993

j. Electrofishing or netting rate

Regional. 34^c: 20 Common Galaxias netted at Finns Reserve on 14 August 1991

m. Regionally rare fauna (R3 species)

Regional. 34^c: 7 White-browed Woodswallows in River Red Gums south of Cleveland Avenue near Bonds Road on 1 January 1991

o. Regionally restricted fauna

Regional. 34^c: 20 Cattle Egrets on the river flats south-east of Rosanna Golf Club in August 1990

Outlook

The faunal significance has increased over recent years due to revegetation and habitat enhancement works (e.g. creation of wetlands) in Yarra Valley Park. Fauna is dependent on maintenance of the upstream habitat link and would benefit from improvement of the downstream link.

FAUNA

Rare or Threatened Fauna

Bb 34^a: Swift Parrot. Recorded at Westerfolds in 1986 (Paul Peake pers. comm.). This section of the Yarra, which contains fewer Manna Gums, does not form a winter roost (compared with the upstream section from Diamond Creek to Sweeneys). At Westerfolds it is likely the parrots occasionally visit habitats supporting Yellow Box/Hill Manna Gum (e.g. central carpark) and River Red Gum, where they would feed on flower buds and leaf psyllids (probably habitats 14.3, 15.1, 16.2 and 30.1).

Bc 34^a: Lewin's Rail. Nested in Common Reed–Cumbungi seasonal wetland (25.7) at a retarding pond along upper Kestrel Creek at Westerfolds in summer 1994/1995 and 1996/97 (Glen Jameson pers. comm.). The Lewin's Rail is dependent on dense seasonal wetland vegetation cover. It feeds on invertebrate prey taken by probing damp mud and low vegetation. The species frequently falls prey to cats in settled areas and foxes. Ponds and dams in Yarra Valley Park provide important nesting habitat for crakes, rails and bitterns.

Bc 34^c: Little Bittern and Baillon's Crake. Both of these rare waterbirds were seen in Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) while triplining for bats (see below) at a dam south of Cleveland Avenue on New Years Eve 1990. While waiting at sundown for the bats to emerge, the sound of a landing bird was heard from the southern end of the dam. Under torchlight, a Little Bittern was observed on a raft of Tall Spike-sedge built by Dusky Moorhens. This species feeds on small frogs and fish, tadpoles and invertebrates. The bittern shortly gave a sharp barking call and departed. There are no other recent records along the Yarra. The paucity of records is likely due to their secretiveness. They appear to be locally mobile and there is a fair element of chance in observing them.

Late in the afternoon while setting up the bat tripline, a glimpse of an unidentified dark-coloured crake was made amongst a clump of spike-sedge in the middle of the dam. It was initially thought to be a Spotless Crake. However, under torchlight later in the evening a parent Baillon's Crake with three chicks was observed swimming and flitting

around the Cape Water-lily pads. This species has been recorded elsewhere on the Yarra at Bailey's Billabong in Ivanhoe, Pettys Wetland upstream at Lower Templestowe and at Yering Backswamp. The Baillon's Crake and Little Bittern may be more widespread at well-vegetated billabongs and floodplain wetlands along the Yarra than survey records suggest.

Bc **34^b: Australasian Bittern.** First seen at Birrarrung Park on 5 August 1979. The species was seen on several occasions in 1986/87 (J. Brandon pers. comm.).

Bc **34^{ab}: Black Falcon.** One observed at Westerfolds on 12 September 1994 (Glen Jameson pers. comm.) and at Birrarrung Park in winter 1986 (J. Brandon pers. comm.). This bird of prey is associated with the timbered plains in Victoria. They appear in the Yarra Valley mostly as single birds during autumn–winter, possibly dispersing from the plains of northern and south-western Victoria. Also recorded upstream at Paddles (site 57) in August 1992, April 1993 and September 1994 (Glen Jameson pers. comm.).

The Black Falcon (along with several other birds of prey such as the Collared Sparrowhawk) has become more common in the Lower Yarra since the early 1990s. This is largely the product of extensive streamway revegetation work in Yarra Valley Park which has provided prey and nesting habitat. Along with the re-established floodplain riparian woodland habitat, the improvement of habitat links and creation of floodplain wetlands has provided habitat for prey species. Other rarer species such as the Grey Goshawk are also beginning to appear at greater frequency.

Bc **34^a: Powerful Owl.** Observed at Westerfolds on 3 May 1995 (Glen Jameson pers. comm.). In 1995 and 1996 a pair nested 2 km upstream opposite the mouth of Diamond Creek. See site 35 for further discussion.

Bc **34^a: Large-footed Myotis.** One observed coursing over open water amongst overhanging River Red Gum (billabong) floodplain riparian woodland (16.1) at Montpelier Billabong on 2 December 1993. The species likely roosts in hollows in River Red Gums at the billabong or along nearby sections of the river. The Large-footed Myotis is rare in GM with about a dozen records, including upstream in Pound Bend tunnel in May 1989. It is thinly distributed along the larger streams and at various aqueduct tunnels and reservoir outlet tunnels. The species forms small maternity colonies, shared with one territorial male (Strahan 1988).

The Large-footed Myotis invariably roosts near, and preferably over, water (Ellery Hamilton-Smith pers. comm.). This includes caves in cliffs (e.g. Plenty Gorge), tunnels and tree hollows. In aqueduct tunnels they share roost sites with Common Bent-wing Bats while over-wintering and hang in communal clusters, probably to reduce body temperature loss. In summer they often roost singly, and crawl behind rock slabs in cliffs and tunnels or enter tree-hollows. The myotis has similarities in breeding behaviour and habitat use with long-eared bats.

The Large-footed Myotis forages over waterbodies and slow-flowing watercourses. It is usually seen as a single animal coursing low over water for night-flying insects, many of which are aquatic-dependent, such as mayflies, caddisflies, midges and mosquitos. Two animals have been seen on occasion hunting over a 'grid' in formation where one follows through after the other. The flight is a moderately swift, zig-zagging pattern with considerable horizontal manoeuvrability. They are reported to rake the water surface with their long feet for small fish, tadpoles and insects, particularly aquatic larval stages and moths that have been washed in after rains. Studies conducted in forests reported fragments of ants and cockroaches in their stomach contents. Faecal analyses (which only detect hard-bodied or large-winged insects) have recorded moths, beetles and winged termites as important dietary items.

They appear sedentary and occupy relatively small home ranges. They probably were formerly more common along the lower stream systems but riparian habitat loss and modification, water pollution and instream ecosystem alteration have apparently eliminated them. The species will abandon cave roosts if disturbed by humans.

Bc **34^{abc}: Likely occurrence of Pouched and Short-headed Lampreys.** Juvenile stages of both species have been recently taken below Dights Falls (Tarmo Raadik pers. comm.). The installation of a fish-way at the falls would have increased the incidence of upstream migration of freshwater lamprey. The Pouched Lamprey was recorded in the Yarra River at Yarra Glen in 1970 and Templestowe in 1890. There is a Museum of Victoria specimen of the Short-headed Lamprey from Finns Reserve in 1975 and one was recently (July 1993) netted at Pound Bend. Short-headed Lampreys are migratory and reasonably tolerant of turbid water conditions. Both lamprey species have been recorded in 1991/92 in tributaries of the upper Yarra River (Raadik in prep.). These must pass through the Lower Yarra to complete their breeding migration. Lampreys live in muddy substrates and conventional netting and electrofishing surveys often

fails to detect them. Specific survey is required, particularly in establishing whether the site supports adult breeding habitat.

- Bc* **34^{abc}: Possible local extinction of Freshwater Blackfish.** There are several records of Freshwater Blackfish from the 1960s and 1970s (Raadik in prep.): at the junction of the Plenty River in April 1964, Westerfolds in March 1966, and Finns Reserve in 1971. There are no records of blackfish being recently caught by anglers in this section of the river. Their current status in the Lower Yarra is considered uncertain (possibly extinct) due to declining water quality and competition from introduced species (aliens such as the Brown Trout and non-indigenous natives such as the Macquarie Perch and Murray Cod). Specific survey is required to ascertain the current status of Freshwater Blackfish.

Other Significant Fauna

Birds

- Eb* **34^b: Intermediate Egret.** This is a rare species in GM, being recorded on only six occasions since 1986. Most observations were of one to three birds, at wetlands containing recently flooded grassy margins. They stand in waiting for their prey, usually small fish and frogs. One was seen at Birrarrung Park in early winter 1987 (J. Brandon pers. comm.). The species had been previously recorded on 19 April 1979. The Intermediate Egret appears to be a sporadic autumn–winter visitor. The nearest breeding grounds are in the Murray Valley, where populations appear to be declining due to flood mitigation (Emison *et al.* 1987).
- Ec* **34^a: Black-eared Cuckoo at Montpelier Billabong.** One amongst Black Wattle and Tree Violet scrub under River Red Gum floodplain riparian woodland (16.1) fringing the billabong on 2 January 1991. The scrub contained nesting Yellow Thornbills and Yellow-rumped Thornbills. Both thornbill species act as foster parents to fledgling Black-eared Cuckoos. This was the only record of the cuckoo along the Yarra. A Spiny-cheeked Honeyeater was observed feeding on African Box-thorn berries in the scrub by the billabong.
- Ed* **34^c: White-browed Woodswallow.** Seven birds including three juveniles in River Red Gum grassy woodland (14.3) along Cleveland Avenue, just east of Bonds Road over the first week of January 1991. They were not on migration and likely bred in the area.
- Ee* **34^a: Buff-banded Rail and Latham’s Snipe.** The developing floodplain terrace seasonal wetlands at Westerfolds are becoming increasingly important for both species and the Stubble Quail. The Buff-banded Rail was recorded on 31 December 1992, 11 February 1993 and 27 May 1994 (Glen Jameson pers. comm.). One was seen in this study in rank grassland adjacent to Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at an artificial terrace swamp by the Main Yarra Trail in the north-east section of Westerfolds on 8 January 1995. The rail likely bred in the area.

Two to four Latham’s Snipe were frequently flushed in January 1995 from the terrace swamp where the rail was observed. Six snipe were also recorded in the Montpelier Billabong area on 2 December 1993. Four were under River Red Gum floodplain riparian woodland (16.1) on the mudflats of the billabong and two were nearby under River Red Gum floodplain riparian woodland (16.2) on the riverbank. Excessive disturbance from humans and unrestrained dogs will remain a limiting factor on the number of cover-dependent waterbirds visiting the Westerfolds wetlands.

- Ee* **34^a: Australian King-Parrot.** Three observed at Westerfolds in River Red Gum floodplain riparian woodland (16.2) in the western section on 13 June 1995 and one observed in River Red Gum grassy woodland (14.3) in the central section on 17 November 1994 (Glen Jameson pers. comm.). The parrot is normally a winter visitor for ripening fruit and flower buds of eucalypts and also orchard fruit. Revegetation works, particularly along the streamway, have encouraged several mountain forest bird species (including the Powerful Owl) to visit the site. Protection of habitat links (particularly Watsons Creek) to the mountains will be vital for these species.
- Ee* **34^c: Rainbow Bee-eater.** Two birds hawking insects over the canopy of River Red Gum grassy woodland (14.3) along Cleveland Avenue, just east of Bonds Road on 1 January 1991. They possibly bred along the lower Plenty River. The bee-eater has become very rare in the Lower Yarra and appears to be facing local extinction.
- 34^b: Birdlists for Birrarrung Park.** Almost 100 native species, including over 30 species of waterbirds have been recorded on the combined lists of Celia Browne of the Bird Observers Club, J. Brandon and Paul Peake, since the establishment of the park in 1979. An oxbow lagoon and surrounding herbfields in combination with the Yarra River provide important waterbird habitat in the context of the Yarra Valley. The river is fringed by River Red Gum floodplain

riparian woodland (16.2). The undergrowth, along with extensive plantations of Silver Wattle, Black Wattle and Blackwood established along the floodplain, provide secluded roosting areas. The lagoon contains Common Reed–Cumbungi seasonal wetland (25.7). It supports populations of Mosquito Fish, Roach, Goldfish and frogs which are prey for waterbirds. The freshwater meadow/pasture of the floodplain is important for waterbirds and frogs after heavy rains. Birrarrung Park is located near the junction of the Plenty River and lies on a three-way habitat link.

Nankeen Night Herons appear on each of the three lists. In a visit made during this survey, four including two juveniles were seen on 31 August 1990, roosting in River Red Gum floodplain riparian woodland (16.2) along the river between Birrarrung Park and the mouth of the Plenty River. This section contains an expanding population of night herons and provides the mid-point in their main distribution along the Yarra. The range of the species is also expanding along the Plenty River. Night herons may breed locally. Hardheads, which are rare in the Lower Yarra, were recorded by Browne and Brandon. The equally rare Musk Duck was recorded by Brandon. Darters were recorded by both Browne and Brandon. Latham's Snipe visit in spring–summer.

Chestnut-breasted Mannikins were sighted by Browne and Brandon in 1979. These would derive from escaped aviary populations. They form flocks of up to 15 birds and feed on seeds by climbing over tall reeds and canary-grass. The wet years of the late 1970s favoured the establishment of this tropical species and there were several reported breeding attempts near Melbourne. The populations died out during the 1982–83 drought. The mannikin may have reappeared over wet years in the mid-1990s.

34^c: Waterbirds of the flats between Cleveland Avenue and the Yarra River. Fourteen species were recorded on 1 January 1991 during a pre-dusk walk along the drainage line from Cleveland Avenue (just west of Bonds Road) south across river flats (horse paddocks) to another a drainage line located south-east of Rosanna Golf Club. This contained a drying shallow marshland surrounded by mudflats (Rush Sedge seasonal wetland; 25.1). Six Dusky Moorhens with young were present at a dam south of Cleveland Avenue (Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland; 25.7) and a Buff-banded Rail was flushed from the lower section of the drainage line on the river flats.

Six Pacific Black Duck, ten Australian Wood Duck, a pair of Australasian Grebe, a Little Pied Cormorant and a Yellow-billed Spoonbill were present in the marshland south-east of Rosanna Golf Club. Two Latham's Snipe were flushed from the rush-beds and a Brown Quail was heard calling. A Black-winged Stilt was also observed in January 1992 (Glen Jameson pers. comm.). Flocks of up to 20 Cattle Egret and 30–40 Australian White and Straw-necked Ibis congregated on the river flats in August 1990.

34^{ac}: Breeding parrots. The site was not surveyed during the main parrot breeding season in spring. Of the thirteen indigenous species recorded, nine are likely to breed. The Yellow-tailed Black-Cockatoo, Gang-gang Cockatoo, Little Corella and Australian King-Parrot are non-breeding visitors. The Little Lorikeet, Red-rumped Parrot and Crimson Rosella were nesting in River Red Gum (plains) drainage line woodland (30.1) along Kestrel Creek at Homeshow Trail in January 1990. The Long-billed Corella and Sulphur-crested Cockatoo were seen inspecting hollows in River Red Gum grassy woodland (14.3) near Cleveland Avenue in late August 1990. On a return visit in December 1991, the Long-billed Corella, Rainbow Lorikeet and Eastern Rosella were nesting in the River Red Gums. The Scaly-breasted Lorikeet and Australian Ringneck were also observed in the site. These have established from aviary escapees and are both frequently seen in the eastern suburbs.

34^a: Forest birds of the north side of the river opposite Westerfolds. The section contains Long-leaf Box–Manna Gum escarpment woodland (13.1) over dense Burgan and Silver Wattle on the lower escarpment while Yellow Box–Candlebark grassy woodland (14.6) occurs on the upper escarpment. On 31 August 1990 the Brush Bronzewing, Bassian Thrush, Crescent Honeyeater, White-eared Honeyeater and Olive Whistler were seen in the scrub. Each species except the bronzewing is a winter visitor. Each has become very rare in the Lower Yarra and is seldom encountered nearer Melbourne.

34^c: Southern Boobook. A pair emerged from a dead River Red Gum (grassy woodland; 14.3) south of Cleveland Road on 31 December 1990. Their young called from the hollow periodically through the night as the adults returned with food.

Mammals

Ef **34^a: Koala.** Observed at Westerfolds on 12 July 1993 and 11 November 1993 (Glen Jameson pers. comm.). They had not been observed previously, indicating a population expansion is occurring from Warrandyte, assisted by revegetation works along the streamway. Movements are bottlenecked by Fitzsimons Lane (see Management). Koalas are dependent on the maintained health of mature trees, particularly Manna Gum, Hill Manna Gum, River Red Gum and Yellow Box (see eucalyptus dieback in Threatening Processes).

Old record of the Greater Glider. There were reports last century of this species occurring on the River Red Gum floodplain at Templestowe (Le Souef 1890). This marsupial became extinct in the Lower Yarra within 10 to 20 years of European settlement. Its range has now contracted to the ranges in NEM.

Bats. The last evening of 1990 was spent at a dam south of Cleveland Avenue. A bat tripline had been set over the small area of open water at the north end of the dam. The evening was very warm but bat activity over the dam was very low and none were caught. On the previous evening the sky had been thick with bats. Trapping the site over the following fortnight yielded few returns.

Two bat traps were set in a likely area under overhanging River Red Gums in the lagoon north-east of Odyssey House. A Pacific Black Duck was caught, but no bats. Trapping bats is unpredictable, particularly near a river. After intensive trapping effort, five common species were obtained and one other was heard (White-striped Freetail Bat). Eight or nine species including the Eastern Freetail Bat and Eastern Broad-nosed (both recorded upstream at Thomsons) would be expected to be present.

Reptiles

Ed **34^a: Murray River Tortoise.** Two were observed in the river downstream of Westerfolds rapids on 30 December 1994, suggesting a substantial population may be present. The carapace of another was collected in 1990 (Pat Fricker pers. comm.). This species is native to the Murray River system in Victoria and has been introduced to the Yarra by the liberation of pets. It has undergone a decline throughout its natural range largely as a result of fox predation of eggs. For this reason, populations in the Yarra are considered significant.

Ed **34^a: Gippsland Water Dragon.** One was seen at the main Westerfolds rapids (near observation deck) on 21 February 1995 (Damien Cook pers. comm.). The species has also been recorded downstream at Yarra Bend, where it may even be breeding. Populations along the Yarra are likely derived from released animals. The nearest natural occurrence is in central Gippsland. It is possible (though unverified) that water dragons were originally native to the Yarra and there is an improbable chance that these have survived. If this were proven, the species would be listed regionally endangered (R1) rather than regionally rare (R3).

Ee **34^c: Red-bellied Black Snake.** One hunting Peron's Tree Frogs amongst seasonal wetland (25.7) at a dam south of Cleveland Avenue on 31 December 1990. The evening was very warm and the tree frogs were calling. A house has since been built near the dam, the grassy fringe is mown and logs have been removed. It is unlikely that the timid black snake remains.

Ef **34^{ac}: Delicate Skink and Tussock Skink.** Cohabitants of Kangaroo Grass areas under River Red Gum grassy woodland (14.3) south-west of Westerfolds Manor and south of Cleveland Road. The Delicate Skink is also found in the native grassland areas associated with Hill Manna Gum sand-plain woodland (15.1) on the central carpark ridge. The Tussock Skink is locally rare and mostly occurs on the volcanic plains. It extends onto the alluvial plains along the Lower Yarra. Westerfolds is its eastern range limit in Greater Melbourne. Loss of ground logs and surface rocks has reduced the numbers of Tussock Skink.

Frogs

Ec **34^{ac}: Peron's Tree Frog.** Resident at most of the permanent floodplain wetlands and dams fringed by Common Reed-Cumbungi seasonal wetland (25.7). They are most often recorded by their raucous cackling on warm summer nights. Yarra Valley Park supports the main population (over 50% of all records) of the species in GM.

Ef **34^{ac}: Common Spadefoot Toad.** Calling after rain from Rush Sedge seasonal wetland (25.1) south-east of Rosanna Golf Club on the evening of 31 August 1990. River Red Gum (plains) drainage line woodland (30.1) would have formerly been present along the drainage line feeding the swamp. Also calling after rain on the floodplain terrace amongst River Red Gum floodplain riparian woodland (16.3) in the western section of Westerfolds on 5 February 1990.

One was located in Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) at an artificial terrace swamp by the Main Yarra Trail in the north-eastern section of Westerfolds on 18 May 1995. The Common Spadefoot Toad is characteristic of the River Red Gum plains of northern Victoria and volcanic plains of south-western Victoria and does not occur east of Diamond Creek in southern Victoria. The toad calls and breeds in bursts after heavy rain from late summer to late winter.

34^a: Westerfolds–Montpelier Billabong. The area supports a high diversity of frogs with 11 species being recorded. The reasons for this are the presence of a diverse array of wetland habitats and the area forming an intact meeting point of alluvial plains grassy woodland and foothill forest. Similar to the Plenty Gorge, there is an overlap of plains and foothill species (e.g. Peron’s Tree Frog, Bibron’s Toadlet and Common Spadefoot Toad with the Victorian Smooth Froglet). After heavy rain eight species were heard calling from the river, billabongs, floodplain terrace and seasonal wetland between Montpelier Billabong and Westerfolds rapids on the evening of 5 February 1990. These included the Common Spadefoot Toad, Victorian Smooth Froglet and Striped Marsh Frog.

Freshwater fish

Ec **34^c: Australian Smelt.** Seine-netted at Finns Reserve on 14 August 1991 (Raadik in prep.). Smelt are common in the Yarra between Templestowe and Warrandyte but are uncommon to rare elsewhere in NEM. Twenty Common Galaxias (*Ed*) were also seine-netted. It was thought that the installation of a fish-way at Dights Falls would greatly increase the galaxias population in this section of the river. This does not appear to have occurred and it is possible that the species, being a poor climber, may be unable to negotiate the fish-way (Tarmo Raadik pers. comm.). This is currently being investigated and the design may need some modification.

Ed **34^a: Freshwater Catfish and Macquarie Perch.** There have been reports of Freshwater Catfish taken at Westerfolds in 1988 and 1992. Specimens weighing up to 3 kg, derived from released populations (source unknown), have been caught on rare occasion by anglers in the Lower Yarra. They have been only recently recorded (since 1988) and are probably unable to breed in the cool waters of the Yarra. In Victoria, catfish are native to the warm inland waters of the middle and lower Murray River system (where populations are declining). The Macquarie Perch has also been released and is breeding in the Yarra. This species is occasionally reported by anglers and was taken at Westerfolds in gill nets during a fish survey on 28 February 1985 (Raadik in prep.). Both the Freshwater Catfish and Macquarie Perch are now listed as vulnerable in their natural range in Victoria and sightings in the Yarra are regarded as significant.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. An intact riparian habitat link upstream to the Lower Eltham Park–Wingrove Park–Thomsons site, downstream to the Banyule Flats–Warringal Swamplands site and Plenty River Flats site.</p>	
<p>Strategic Habitat Link. The Bonds Road–Birrarrung Park–Westerfolds Park site is a strategic habitat link in North East Melbourne.</p>	
<p>Fitzsimons Lane is a major obstruction in the fauna habitat link from upstream areas. The four lane highway has 24-hour traffic flow. It is a significant barrier to the movement of ground fauna and arboreal mammals such as Koalas from upstream areas. A bottleneck access point on the south side of the river under the bridge is shared by a vehicle track, Main Yarra Trail and carpark. This is the only point that species can move from upstream areas to Westerfolds. Constant day usage by humans and numerous fences severely limit the movement of fauna. Location of the Main Yarra Trail on the weak point in the habitat link does the same.</p> <p>Habitat fragmentation and eucalyptus dieback. Many of the mature trees, particularly Manna Gum, Hill Manna Gum, River Red Gum and Yellow Box are in declining health because of habitat fragmentation and dieback from a combination of factors, including colonies of Bell and Noisy Miners which promote leaf insect attack, alteration of soil drainage patterns, ground disturbance (weeds, nutrient enrichment and compaction from past livestock grazing), exposure due to stand thinning and understorey removal and Cinnamon Fungus. Foliage loss caused by native insect species is the most frequent cause of dieback in the Yarra Valley (see volume 1).</p>	<p>Strengthen habitat links. Further development of the floodplain riparian woodland and grassy woodland river frontage will be required to maintain the present fauna populations and strengthen the utility of the site as the innermost viable habitat link along the Yarra River system.</p> <p>Investigation into easing the bottleneck and barriers at the Fitzsimons Lane bridge is required otherwise the effectiveness of the site as a Strategic Habitat Link will remain limited. Movement of wallabies, wombats (etc.) between Zerbes and Westerfolds would be improved if the section of fence adjoining the river were removed. Low barriers to prevent vehicle entry from the carpark would need to be installed. Access from Fitzsimons Lane should be closed off at night.</p>

Regional Hydrological Strategy

Brown Trout release at Fitzsimons Lane. Three thousand were released by NRE Melbourne Region into the Yarra at Fitzsimons Lane in spring 1992. Brown Trout are voracious predators of the young of native fish and would compete for food with several threatened native species including the Spotted Galaxias and Australian Grayling.

Declining riverbank and water quality of the Yarra. Past farming and urban land-uses upstream including clearing and grazing have led to stabilising native vegetation along the river being replaced by White Crack Willow and Blackberry. This has caused severe bank erosion. As willows grow out into the water they become undermined by the current and slump into the river, taking the banks with them. This disrupts the flow, leading to siltation. Islands at rapids fragment into series of channels. Perennial herbs and substrate are scoured away during flood episodes. Silt from eroding surfaces dumped into the sandy bays downstream of rapids has smothered the instream herbfields. These are being further eliminated by European Carp.

Eutrophication at Montpelier Billabong. Shading and competition from willows and Blackberry have depleted the native understorey and (along with nutrient input) promoted shade-tolerant weeds such as Madeira Winter-cherry. This has closed up the ecosystem to sufficient light, vital for aquatic life and nutrient turnover. European Carp have depleted the submerged/floating meadows and made the water turbid. The closed billabong has input from an urban drain at the west end. Eutrophication results over summer as the water and dissolved oxygen levels drop and water temperature rises. Advanced stages have developed in several other billabongs in the Lower Yarra (e.g. Bailey Billabong, East Ivanhoe). Dissolved oxygen is critical to maintaining instream ecosystems, particularly aerobic bacteria which are vital for the breakdown of pollutants. Insufficient levels lead to anaerobic decomposition of organic material, production of noxious gases such as hydrogen sulphide and methane and chemical reduction of iron and manganese. Aerobic conditions enable the oxidation of heavy metals to oxides which are absorbed in a natural process into the substrate.

Difficulty of reversing the decline. Native vegetation cannot effectively re-establish areas of heavy infestation of willows and Blackberry. Even with their removal, areas are prone to recolonisation by disturbance weeds such as Wandering Jew, Three-cornered Garlic and Blue Periwinkle. The severity of the natural river dynamics, combined with the elevated nutrient, siltation and disturbance regimes, has led to a degradation cycle. This is only slowly reversible through substantial conservation works.

Eutrophication at Montpelier Billabong. European Carp and environmental weeds (particularly willows and Blackberry) at Montpelier Billabong require control. The urban drain at the west end of the lagoon requires a hard-rubbish trap. Drains and culverts disseminate large volumes of contaminated stormwater quickly, but do not promote the aerobic cycle. Flow needs to be slowed and diverted through a retarding pond. Aquatic vegetation in the pond will trap pollutants and nutrients for sufficient time to stabilise the aerobic cycle and aquatic ecosystem.

Other Issues

Widespread threatening processes. Sixteen environmental risks have been identified by the Westerfolds Park Environmental Management Plan (July 1996). These fall into five main groups:

- 1 *Habitat fragmentation*; loss of habitat links due to clearing of native vegetation for agricultural/urban land; eucalyptus dieback
- 2 *Habitat quality decline* from poor catchment management; water pollution (residential runoff in Kestrel Creek contains high sediment loads and heavy metal contaminants); riverbank erosion/degradation due to rabbit and human activity; gully/hill-slope erosion due to rabbit activity, high velocity residential stormwater and vegetation removal by land clearing and grazing
- 3 *Urban/human disturbance*; residential development impact (including pets), recreation pressure including horse riding, fire
- 4 *Declining native species populations* due to active extinction processes
- 5 *Alien species impact*; weed competition and rabbit grazing of native flora; fox predation of native fauna and spread of berries of woody weeds; tree hollow competitors, particularly Common Mynas and Starlings, Honey Bees and European Wasps

Rehabilitation and management of Westerfolds

Park. This study provides a biological values assessment. Other studies have mapped and assessed the vegetation communities and identified the location of significant plants. For further threat/risk identification refer to the fauna management plan (Larwill *et al.* 1991) and Westerfolds Park Environmental Management Plan (July 1996). Conservation measures to improve biological values include:

- Protect significant flora and fauna and stands of vegetation
- Reduce recreation impact: e.g. Main Yarra Trail usage and disturbance to birdlife
- Provide for ongoing research and monitoring programs and resource allocation to maximise conservation efficiency or identify information gaps; e.g. eucalyptus dieback, ecological burns
- Undertake native species propagation, planting and revegetation
- Undertake pest plant and animal control
- Undertake land protection works; riverbank and gully erosion control; stormwater management
- Enhance habitat links and reduce barriers to faunal corridors
- Expand community education and involvement through nature conservation and environmental interpretation programs

Wetland development of the river flats south-east of Rosanna Golf Club.

Protection of River Red Gum woodland on private property in the Cleveland Avenue area. A specific plan of management is required.

Site 35 Lower Eltham Park–Wingrove Park–Thomsons

- Map Reference:** 7922 356212 to 7922 370217 (Yarra River, Fitzsimons Lane to upstream of Diamond Creek); 7922 366215 to 7922 363230 (Diamond Creek, Yarra to Dalton Street); 7922 364225 (Wingrove Park Eltham); 7922 364216 (Lower Eltham Park); 7922 358217 (Hohnes Hill); 7922 368215 (Thomsons); 7922 368216 (Griffith Park). One minute lat/long grids include 37°43' x 145°08' and 37°44' x 145°08'.
- Location/Size:** Approximately 390 ha.
- Municipality:** Shire of Nillumbik and City of Manningham (south of the Yarra).
- Land Tenure/Use:** Public: Zerbes and Thomsons sections of Yarra Valley Park (Melbourne Parks & Waterways). Wingrove Park, Lower Eltham Park/Hohnes Hill, Lenister Farm and Griffith Park (Shire of Nillumbik). Private: bushland fronting the Yarra (Homestead/Banoon Roads) and Diamond Creek (Antoinette Boulevard).
- Landforms:** Foothill and alluvial plain (see YLAP E). Elevation is 14–60 m.

Scientific and Educational Values

Rehabilitation and management. Extensive rehabilitation and conservation works have been undertaken in this section of Yarra Valley Park.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: River Red Gum (alluvial plain) grassy woodland (14.3)

Relatively intact and extensive stands: River Red Gum (plains) drainage line woodland (30.1)

Partially intact or small stands: Manna Gum (riverbank) riparian forest (5.1); Manna Gum (terrace) riparian forest (5.2); Manna Gum (creek) riparian forest (5.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Long-leaf Box–Manna Gum escarpment woodland (13.1); Yellow Box–Candlebark grassy woodland (14.6); River Red Gum (riverbank) floodplain riparian woodland (16.2); River Red Gum (terrace) floodplain riparian woodland (16.3); Muttonwood riparian scrub (18.1)

Remnant, degraded or establishing stands: Swamp Gum gully woodland (10.3); Yellow Box escarpment woodland (13.2); Burgan–Sweet Bursaria (sheltered) cliff/escarpment shrubland (20.2); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Rare species: Stream Club-sedge, Short Water Starwort, Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Strategic Habitat Link. River Red Gum (alluvial plain) grassy woodland (most intact stand remaining in NEM).

FAUNAL SIGNIFICANCE: Site 35 Lower Eltham Park–Wingrove Park–Thomsons

Assessment: State—Category 2 (B, C, D, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

35^a: 37°43' x 145°08'; Diamond Creek–Wingrove Park

35^b: 37°44' x 145°08'; Diamond Creek/Lower Eltham Park–Thomsons/Yarra River

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 35^b: Eltham Copper butterfly

b. Vulnerable fauna

State. 35^{ab}: Swift Parrot. Repeated sightings at Wingrove Park (18 May 1989 and 30 April 1990), Lower Eltham Park/Diamond Creek (26 May 1988 and 30 April to 10 July 1990) and Griffith Park (30 April 1990 and 8 April 1992)

c. Rare fauna

Regional. 35^b: Powerful Owl (sighting at Hohnes Hill on 22 June 1993 and nesting at Thomsons in 1995 and 1996), Eastern Broad-nosed Bat (2 trapped by the Yarra at Thomsons on 11 January 1991), Freshwater Blackfish (lower Diamond Creek in 1991)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

g. Breeding parrots

Regional. 35^b: 6 species including the Rainbow Lorikeet (5 pair), Crimson Rosella and Red-rumped Parrot (5 pair) at Lower Eltham Park on 19 October 1989

h. Bats

State. 35^b: 8 species including the Eastern Freetail Bat, Gould's Long-eared Bat and Eastern Broad-nosed Bat trapped at Thomsons by the Yarra about 200 m upstream of Diamond Creek from 10-12 January 1991

l. Reptiles

Regional. 35^b: 11 species including the Marbled Gecko and White's Skink at Thomsons/Lower Eltham Park between 10 and 12 January 1991

m. Freshwater fish

Regional. 35^b: Macquarie Perch (5) and Australian Smelt (1) by mesh net at Thomsons on 22/23 July 1993

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 35^b: over 140 species

b. Native birds

Regional. 35^b: over 90 species

c. Native mammals

Regional. 35^b: 20 species

d. Herpetofauna

Regional. 35^b: 23 species

e. Freshwater fish

State. 35^b: 7 species

f. Butterflies

Regional. 35^b: 24 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 35^b: 24 species

b. Regionally endangered fauna (R1 species)

Regional. 35^b: 2 species. **Mammals:** Eastern Broad-nosed Bat. **Butterflies:** Eltham Copper

c. Regionally vulnerable fauna (R2 species)

Regional. 35^b: 5 species. **Birds:** Little Egret. **Mammals:** Eastern Freetail Bat. **Fish:** Australian Smelt, Freshwater Blackfish. **Frogs:** Peron's Tree Frog

d. Regionally rare fauna (R3 species)

State. 35^b: 9 species. **Birds:** Little Corella, Pink Robin. **Mammals:** Feathertail Glider, Gould's Long-eared Bat.

Reptiles: Marbled Gecko. **Fish:** Common Galaxias, Freshwater Catfish, Murray Cod, Macquarie Perch

Regional. 35^a: 3 species. **Birds:** Collared Sparrowhawk, Pink Robin. **Mammals:** Grey-headed Flying-fox

e. Regionally depleted fauna (R4 species)

Regional. 35^b: 8 species. **Birds:** Swift Parrot, Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, Speckled Warbler. **Mammals:** Platypus. **Reptiles:** White's Skink. **Butterflies:** Small Copper

Local. 35^a: 1 species. **Birds:** Swift Parrot

f. Regionally restricted fauna (R5 species)

Regional. 35^b: 13 species. **Birds:** Cattle Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Rainbow Lorikeet, Little Lorikeet. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink, Bougainville's Skink. **Butterflies:** Doubleday's Skipper, Meadow Argus, Dark Purple Azure

Local. 35^a: 2 species. **Birds:** Rainbow Lorikeet, Nankeen Night Heron

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 35^{ab}: Swift Parrot (about 130 birds roosting in Manna Gums along Diamond Creek downstream from Wingrove Park to the confluence with the Yarra River and upstream along the Yarra to Griffith Park on 30 April 1990)

n. Regionally depleted fauna (R4 species)

Regional. 35^b: 8 Australian King-Parrots roosting in Manna Gums at Lower Eltham Park on 5 May 1989

o. Regionally restricted fauna (R5 species)

Regional. 35^b: 50 Rainbow Lorikeets roosting in Manna Gums at Lower Eltham Park on 30 April 1990

Outlook

Maintenance of the most significant values depends on visitations by Swift Parrots and the survival of the Eltham Copper colony. Reptiles and mammals will decline with habitat fragmentation and disturbance including cat predation. Much is dependent on the maintenance of habitat links upstream along the Yarra, improvement of the downstream link and minimisation of recreational disturbance (e.g. Main Yarra Trail). If these are well managed, avifauna diversity will increase as the Yarra Valley Park plantations develop.

FAUNA

Rare or Threatened Fauna

Ba 35^b: Eltham Copper butterfly. A small population occurs at Hohnes Hill.

Bc 35^b: Powerful Owl. One recorded at Hohnes Hill on 22 June 1993 (John Handfield pers. comm.). In 1995 a pair nested in a River Red Gum spout in floodplain riparian woodland (16.2) along the Yarra riverbank at Thomsons. The Main Yarra Trail had been recently extended along the river terrace near the tree. Nestlings were hatched but the pair abandoned the site, apparently because of human disturbance. While the birds were present, prey was frequently dropped beneath the nest tree (Glen Jameson pers. comm.). The pair returned in 1996 to nest, but again abandoned. Later in 1996 the spout collapsed.

This is the only known nesting attempt within 20 km of Melbourne. Prior sightings near Melbourne had been in autumn/winter and were usually of juvenile birds. It is unknown whether the owls nested in 1993, or whether the sighting was a juvenile dispersing from elsewhere (e.g. Pound Bend). The Yarra River provides the critical habitat link for the owl. Suburban possums may be of increasing importance to their survival in NEM but human disturbance will likely prevent successful breeding attempts in these areas.

Bc 35^b: Eastern Broad-nosed Bat. A lactating female and a male were trapped under River Red Gum floodplain riparian woodland (16.2) at Thomsons about 200 m upstream of Diamond Creek on 11 January 1991. The Eastern Broad-nosed Bat is a rare species of seemingly disjunct distribution in eastern Victoria.

Bc **35^b: Freshwater Blackfish.** One taken by a local angler from the lower reaches of Diamond Creek in 1991 (Sue Still pers. comm.). There have been no records in the last decade of blackfish from the Yarra downstream of Diamond Creek. They originally extended down to the City of Melbourne. The nearest upstream record is from below Pound Bend (site 57). Turbidity restricting their reproductive success and competition and predation from introduced bottom feeders (e.g. Macquarie Perch) are their main problems.

Critical Assemblages or Populations

Bb/Fb **35^{ab}: High population density of Swift Parrots.** On the evening of 30 April 1990, 130 birds roosted in Manna Gum riparian forest along Diamond Creek downstream of Eltham from Wingrove Park to the confluence with the Yarra (5.3) and upstream along the Yarra to Griffith Park (5.1). This was part of a flock that had been tracked from Plenty–Janefield (site 42) over the previous two evenings. Birds continued roosting until late July. This area and upstream to the mouth of Mullum Mullum Creek (site 57) is the only known Swift Parrot roost in NEM. The site is a traditional roost for parrots, particularly the Rainbow Lorikeet (over 50 birds) and Australian King-Parrot in winter (up to 10 birds).

Swift Parrots appear at Eltham in large numbers at intervals of about one year in ten (1990 between 1986 and 1996). They were recorded in four out of five years from 1988 to 1992 but apart from 1990, only in small numbers. They were not observed from 1993 to 1996. In years such as 1990, they arrive from Tasmania in March and return to breed in September. Movements are unpredictable and determined by local nectar flows (particularly Yellow Gum and Swamp Gum). In years when Swift Parrots are locally rare or absent, they have been recorded feeding on nectar and psyllid insects (lerp) in box–ironbark woodlands across northern Victoria and southern New South Wales.

Ch **35^b: High diversity of bats.** Stands of hollow-bearing Manna Gums and River Red Gums along streams are important for bats (and parrots). The site contains one of the most intact areas of overlap of the two eucalypt species in GM. Eight species including the Eastern Freetail Bat, Gould’s Long-eared Bat and Eastern Broad-nosed Bat (each a new species to Yarra Valley Park) were trapped under River Red Gum floodplain riparian woodland (16.2) by the Yarra at Thomsons, about 200 m upstream of Diamond Creek from 10 to 12 January 1991. Manna Gum (riverbank) riparian forest (5.1) occurs upstream along the Yarra and Manna Gum (creek) riparian forest (5.3) occurs nearby along Diamond Creek. This is one of the highest diversities recorded from a single trapping effort in the GM fauna survey. The ninth trapped species in the grid was the Southern Forest Bat at Lower Eltham Park on 1 January 1991. A tenth species recorded in the grid was the White-striped Freetail Bat heard at Lower Eltham Park on 5 May 1989.

Harp trapping for bats in riverine floodplains is seldom rewarding (see Bonds Road site). No bats had been trapped in an intensive trapping effort in the site over the previous week. The Eastern Freetail Bat has a similar distribution to the Eastern Broad-nosed Bat and is largely restricted to lowland streams in GM. The Gould’s Long-eared Bat and Southern Forest Bat are predominantly upland species, seldom trapped closer to Melbourne.

De **35^b: High diversity of freshwater fish.** Seven native species have been recorded in the Yarra and adjoining section of Diamond Creek during the 1990s. These include the Short-finned Eel, Common Galaxias, Australian Smelt, Freshwater Catfish, Macquarie Perch, Murray Cod and Freshwater Blackfish (see Other Significant Fauna: freshwater fish). There is also a Museum of Victoria specimen of the Short-headed Lamprey from the Yarra River at Lenister Farm in 1975. This species would still be present. Since the installation of the fish-way at Dights Falls, several additional migratory species including the Tupong may reside or move through (see site 57).

Other Significant Fauna

Birds

- Ed* **35^{ab}: Pink Robin.** Observed in Manna Gum riparian forest (5.3) by Diamond Creek at Wingrove Park on 18 May 1989 and at Lower Eltham Park on 13 April 1992. This species descends into lowland areas from the mountains during autumn–winter.
- Ee* **35^b: Australian King-Parrot—forest habitat link species.** The junction of the Yarra and Diamond Creek is a congregation point of many mountain forest birds, indicative of operative habitat links. Mountain parrots including the Australian King-Parrot, Yellow-tailed Black-Cockatoo and Gang-gang Cockatoo move down the major stream valleys from upland areas for winter. Eight Australian King-Parrots were observed roosting in Manna Gum riparian forest (5.3) by Diamond Creek at Lower Eltham Park on 18 May 1989.
- Ee* **35^b: Leaden Flycatcher and Speckled Warbler.** Both recorded in River Red Gum grassy woodland (14.3) at Thomsons on 10 January 1991. Neither species has been recorded closer to Melbourne along the Yarra.

Mammals

- Ed* **35^b: Feathertail Glider.** Recorded in Manna Gum (terrace) riparian forest (5.2) along Diamond Creek at Antoinette Boulevard (Sue Still pers. comm.).
- Ed* **35^a: Grey-headed Flying-fox.** One feeding on ripe domestic figs in a house garden at Falkiner Street on 22 February 1994 (Paul Sparks pers. comm.). Several recorded in late summer 1992.
- Ee* **35^b: Platypus.** One seen on 16 January 1995 in the Yarra at the confluence of Diamond Creek. A female was dug out of its burrow along the lower Diamond Creek and clubbed to death by local youths in 1990 (Sue Still pers. comm.). While there is no supportive data, Platypus populations have apparently declined in the Lower Yarra, particularly downstream of Diamond Creek. They are uncommon to the Plenty River and rare to locally extinct below (and in the lower Plenty River; see site 27). They would have originally bred in the Yarra downstream to the tidal saltwater interface. They are now limited by water quality decline (particularly pollution from insecticides, heavy metals, detergents and phosphates), habitat decline (nesting sites) and increasing disturbance/predation associated with urban living.

The lower reaches of the Yarra tributaries provide breeding habitat. Instream silt-beds contain Oligochaete worms which are an important dietary component. They are one of the dominant native invertebrate groups of the nutrient-rich silt-beds of the Mullum Mullum confluence (Yugovic *et al.* 1990). Platypus can survive downstream of urban catchments since their foraging ability is not affected by higher water turbidity (hunts by touch). They persist in the lower Mullum Mullum Creek at Yarra Valley Park as this area is kept to relatively low levels of human disturbance. The security enables females to establish breeding burrows. The Yarra provides territory for males and clear water upstream at the Yarra Brae Rapids where other important dietary items abound (e.g. crustacea).

Radio-tracked males have recorded movements within their territories of up to 8 km (Melody Serena pers. comm.). Animals observed in recent years in the lower Diamond Creek could well be residing along the Mullum Mullum Creek (site 57) or further upstream along the Yarra. Lack of security from humans is all that is preventing them from breeding. Improvement in water and habitat quality along Diamond Creek would further benefit them (see Management).

35^b: Other mammals. The Brown Antechinus resides in the roof of a house along Antoinette Boulevard (Sue Still pers. comm.). This species has been eliminated elsewhere from urban Eltham. Sugar Gliders are common along the lower Diamond Creek. The Black Wallaby has recently been sighted at Thomsons (Glen Jameson pers. comm.). This is due to enhancement of the streamway habitat link from Warrandyte and control of dog incursions (e.g. dog fence along the southern housing perimeter).

35^b: Donald Thomson mammal collection. Donald Thomson lived on the east side of Diamond Creek, just upstream of the Yarra. He was an important figure in Australian anthropology and the natural sciences (Dixon & Huxley 1989). As a nature writer for the Herald and Sun in the middle twentieth century he acquired considerable information and animal specimens from his readers. His meticulous observations of captive Eastern Quolls and Brush-tailed Phascogales were important contributions to our understanding of the ecology of these marsupials. Specimens from the lower Diamond Creek in the collection included a Platypus dated 1931, an Eastern Freetail Bat dated 2

December 1933 (the first and only record for GM until it was trapped during the present study), a Brush-tailed Phascogale dated 1944 and a Water Rat dated April 1945 (Dixon & Huxley 1989). Land owned by the Thomsons on the southern side of the Yarra has been incorporated into Yarra Valley Park.

Reptiles

35^b: Thomsons–Lower Eltham Park. Eleven species were recorded in area searches on either side of the Yarra at the mouth of Diamond Creek and at Lower Eltham Park between 10 and 12 January 1991. An additional four species—the Common Long-necked Tortoise, Southern Water Skink, Lowland Copperhead and Eastern Brown Snake—were recorded in surveys from 1988 to 1995. This is the highest reptile diversity along the Yarra River in NEM. The site contains one of the last populations near Eltham of the formerly common Lowland Copperhead and Eastern Brown Snake. These were both recorded in River Red Gum grassy woodland (14.3) at Thomsons on 16 January 1995.

Species recorded on 12 January 1991 include:

- Marbled Gecko: under rubble near Diamond Creek in Manna Gum riparian forest (5.3); confined mainly to the volcanic plains and older suburbs of Melbourne
- Tree Dragon, White's Skink and Delicate Skink: Yellow Box–Candlebark grassy woodland (14.6) at Thomsons
- Blotched Blue-tongued Lizard and Weasel Skink: Manna Gum riparian forest (5.3) at Lower Eltham Park
- Bougainville's Skink: Yellow Box–Red Stringybark box–stringybark woodland (11.2) at Hohnes Hill
- Eastern Three-lined Skink: River Red Gum grassy woodland (14.3) at Thomsons.

Most of these species have not been recorded elsewhere in the management unit. The White's Skink and Tree Dragon have become very rare near Melbourne due to habitat loss and cat predation. Thomsons will become increasingly important for reptile conservation if these threatening processes can be locally constrained. There is a possibility for the White-lipped Snake and Eastern Small-eyed Snake, but these species are difficult to locate.

Freshwater fish

Ec **35^b: Australian Smelt.** One was taken from the Yarra by mesh net upstream of Diamond Creek at Thomsons on 22/23 July 1993 (Pat Fricker & Tarmo Raadik pers. comm.).

Ed **35^b: Common Galaxias, Freshwater Catfish, Macquarie Perch and Murray Cod.** Three Common Galaxias were observed at Thomsons rapids about 200 m upstream of Diamond Creek on 10 January 1991. Five Macquarie Perch were taken from the Yarra by mesh net upstream of Diamond Creek at Thomsons on 22/23 July 1993 (Pat Fricker & Tarmo Raadik pers. comm.). Local anglers have taken the Freshwater Catfish, Macquarie Perch and Murray Cod from the lower reaches of Diamond Creek during the 1990s (Sue Still pers. comm.). These species have been introduced from the Murray River system where they are each listed as vulnerable. The catfish and cod would be unlikely to breed due to low water temperature. A significant breeding population of the Macquarie Perch is present. Each of these species (and the Tupong which may be present) are bottom-feeders and presumably exploit the abundant worm life of the silty substrates (see Platypus; *Ee*).

35^b: Electrofishing Survey: Diamond Creek at the rear of 33 Antoinette Boulevard Eltham

Map reference. 7922 363261. **Altitude.** 30 m. **Survey date.** 13 April 1992 and 7 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield (poor cover and condition). Bank: Manna Gum (creek) riparian forest: (5.3; poor condition; dominated by alien shrubs including White Crack Willow, Hawthorn and Blackberry and alien herbs). Frontage: Manna Gum (terrace) riparian forest (5.2; poor condition); Yellow Box–Candlebark grassy woodland (14.6; poor condition).

Physical Features:

Pools

Substrate. Deep silt, logs, branches, leaves, willow roots and urban refuse on sheet siltstone; channel severely scoured

Maximum size (mid-autumn). 6 m wide by 2.0 m deep by 40 m long

Riffles

Substrate. Gravel, cobbles sand on sheet siltstone

Flow (mid-autumn minimum): **Size.** 3.0 m wide by 10 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 14.3 ML/day. About 60% fed from urban runoff

Flow (mid-winter peak): **Size.** 6.0 m wide by 30 m deep. **Velocity.** 0.8 m/sec. **Rate.** 343 ML/day

Water quality

Autumn: Temperature. 14.0°C. **Conductivity.** 455 ms. **Salinity.** 0 ppt. **Turbidity.** Very high

Winter: Temperature. 10.4°C. **Conductivity.** 155 ms. **pH.** not taken. **Dissolved Oxygen.** 10.0–10.2 ppm. **Turbidity.** High

Fish Recorded During Survey:

Native species numbers/status. Short-finned Eel (3); migratory sub-adult

Alien species numbers/status. Roach (100+); likely breeding resident

Other comments. Redfin, Goldfish and European Carp are also present (Sue Still & Sue Moors pers. comm.).
Land tenure: council reserve and residential blocks containing bushland fronting the creek.

Butterflies

35^b: Lower Eltham Park–Hohnes Hill/Thomsons. This was the only area in the Lower Yarra systematically surveyed for butterflies. Additional information for Hohnes Hill was provided by Michael Braby. Butterfly survey visits were 5 May 1989, 19 October 1989, 1 January 1991, 10 January 1991 (Thomsons), 13 April 1992 and 2 November 1992. 24 species were recorded.

Significant species: Donnyssa Skipper, Doubleday's Skipper, Symmomonus Skipper, Meadow Argus, Dark Purple Azure, Eltham Copper, Small Copper, Common Imperial Blue and Common Dusky Blue. A small colony of the Eltham Copper occurs at Hohnes Hill. Searches should be conducted at Thomsons as the larval food-plant (Sweet Bursaria) of the copper is present.

35^a: Historical records. The Rare White-spot Skipper was recorded from Eltham by Alex Burns and J. Le Souef in the late 1940s (Michael Braby pers. comm.). The only recent observations in NEM were at Nutfield in Yellow Box–Red Stringybark box woodland (11.2) in October 1986 (Nigel Quick pers. comm.) and Plenty–Janefield in November 1993. Larvae of the Rare White-spot Skipper feed on the Wattle Mat-rush. Adults fly for four weeks between late October and late November and in suitable years have a briefer second flight season in late March. They are consequently seldom recorded. The River Red Gum grassy woodland (14.3) at Thomsons should be surveyed for the Rare White-spot Skipper.

The vulnerable Ictinus Blue was taken near Eltham Primary School in the early 1960s (Fabian Douglas pers. comm.). A broad band of Yellow Box–Red Stringybark box–stringybark woodland (11.2) extended from the east end of Dalton Street north-east to Eucalyptus Road. The area is now residential. The Ictinus Blue has undergone a decline in southern Victoria. Recent observations in NEM have only been made in box–ironbark and box–stringybark woodlands at Janefield and Yarrambat in the Plenty Gorge and at Cottles Bridge. The larvae of the Ictinus Blue at Eltham were recorded on the introduced Early Black Wattle (Fabian Douglas pers. comm.). All other observations in NEM have been on Black Wattle. The larvae feed in association with the meat ant, *Iridomyrmex purpureus* group.

MANAGEMENT

Threatening Processes	Conservation Measures
See the Bonds Road–Birrarrung Park–Westerfolds Park site and other units in the Yarra Lowland Plains.	

Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link upstream to the Pettys–Sweeneys–Paddles–Morrison–Glynns site and downstream to the Bonds Road–Birrarrung Park–Westerfolds Park site. A partially intact riparian link upstream along Diamond Creek to the Eltham Township site.

Strategic Habitat Link. The Lower Eltham Park–Wingrove Park–Thomson site is a strategic habitat link in North East Melbourne. These are sites in which habitat link utility is considered critical in the maintenance of faunal/habitat significance (in accordance with the Regional Habitat Link Strategy). The preservation and enhancement of these designated links is a key recommendation of the strategy. Strategic habitat links are the key site/series of sites within a particular biophysical zone or major catchment that are presently or potentially the most critical or important for local fauna movement. The establishment of effective external habitat links is considered critical to the continued viability of faunal populations.

	Strengthen strategic habitat link. Further development of riparian forest and grassy woodland vegetation will be required to maintain the present fauna populations and strengthen the utility of the site as a vital habitat link along the Yarra River system.
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Regional Hydrological Strategy

Streamway disturbance and loss of riparian vegetation. Stream bank vegetation acts as an important buffer from offstream effects such as pollutant, sediment and nutrient runoff, climatic exposure due to loss of shading and disturbance and from human occupied areas. Loss of native fringing vegetation along streams due to human and rabbit/livestock grazing activities is a key factor in the decline of instream fauna. This has caused erosion and turbidity levels to increase and has severely limited aquatic flora and fauna, particularly the Platypus, freshwater fish and invertebrates.	Weed removal and creek management plan. This can only benefit species such as the Platypus. A major rehabilitation and revegetation program is required to restore the water and habitat quality of Diamond Creek and the upstream habitat link to Eltham. White Crack Willow removal and planting of shrubs and grasses has begun. The removal of willows led to further bank collapse and loss of vegetation including ferns. The willows should be drilled, poisoned and left standing as they provide habitat for nest hollow species (e.g. Sacred Kingfisher, Striated Pardalote and Dusky Woodswallow) and roosting waterbirds (e.g. Nankeen Night Heron).
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Electrofishing site. This is one of the most degraded sites sampled during the electrofishing survey. Threats include high turbidity (and probably pollution) rate due to runoff from erosion surfaces and urban areas, adjacent clearing for housing and parkland, severe erosion (creek channelisation due to elevated flow rate, bank slumping and tree and bank undercutting), weed invasion and loss of native riparian and instream cover. Human trampling particularly on the steep eastern escarpment is a major bank disturbance. Creek de-snagging, straightening and rock stabilisation has occurred near the Main Road bridge. An upstream resident mined gravel from the stream bed for driveway toppings. The creek subsequently cut around a downstream cascade and the bank slumped into the water.

Platypus study. A study and follow-up management to redress the decline of the Platypus should be instigated. An authoritative water quality study, breeding habitat assessment and invertebrate (prey) survey is urgently required for the Platypus population in the Yarra River/Diamond Creek. A public awareness exercise is needed to impress an understanding of the need to care for these animals and how important to us is their continued survival as a mammal in a polluted or disturbed environment.

Other Issues

Park management and visitor use pressure on the Eltham Copper.

Rubbish dumping (e.g. garden clippings) in the creek and planting of exotic native shrubs and trees in gardens near by.

Eltham Copper butterfly management at Hohnes Hill. A specific plan of management for protection and enhancement of the butterfly colony is required. Annual counts of larvae and adults should be undertaken.

Management will need to improve if the colony is to survive. This includes cessation of grass slashing adjacent to the colony, weed control, planting of Sweet Bursaria and protection from trampling. The colony area should be fenced. A small area of suitable habitat occurs on the hill-crest of the opposite side of the Yarra River at Thomsons. Survey for the attendant ant should be undertaken. If present, extensive planting of Sweet Bursaria to facilitate the re-introduction and establishment of the butterfly would be desirable.

Rehabilitation and management—Lower Eltham Park.

Rehabilitation and management—Thomsons. This section of Yarra Valley Park should be established as a River Red Gum (alluvial plain) grassy woodland research and revegetation area. It should remain closed to general public access. See the fauna management plan (Larwill *et al.* 1991).

Weed removal and creek management plan

Attacking entire stands of woody weeds in a single operation is inadvisable as these provide habitat for numerous bird species and Common Ringtail Possums. Removal should be conducted systematically over several years (e.g. poisoning one in three each year) in tandem with the establishment of native shrubs. Community cooperation and involvement will be required if creek restoration is to be achieved. Follow-up work including the control of numerous other environmental weeds needs to be undertaken over an extended period.

Target woody weeds to control include White Crack Willow, Blackberry, Prunus, Hawthorn, Japanese Honeysuckle and Ivy. Target herbaceous weeds include Wandering Jew, Three-cornered Garlic, Spear Thistle, Soursob, Bridal Creeper, Purple-top Verbena, Creeping Buttercup, Sweet Vernal-grass, Panic Veldt Grass, Water Couch, Cocksfoot, Yorkshire Fog, Brown-top Bent and Toowoomba Canary-grass.

The consignment of a management plan for the lower Diamond Creek which identifies biological values (e.g. rare ferns) and sets priorities for threatening processes and restoration works is viewed as necessary. This needs to address the role of the lower Diamond Creek in the regional habitat link network. It also needs to detail the requirements of fauna species utilising (or potentially utilising) the link. Work objectives need to be fully integrated with those being undertaken nearby in Yarra Valley Park. The plan also needs to address the upstream section of the creek at Eltham township.

PLENTY UPLAND ALLUVIAL PLAINS (PUAP)

Farmland catchments of the middle Plenty River and lower reaches of its tributaries including Bruces Creek and Scrubby Creek.

Land-use

Past land-use: pastoral and townships. Present land-use: farmlet settlement, urban/township and recreation (e.g. horse riding).

Native vegetation cover

Highly fragmented.

Key biological features

Baillon's Crake, Lewin's Rail, Little Bittern, Australasian Bittern, Sharp-tailed Sandpiper, Latham's Snipe, Painted Snipe, Blue-billed Duck, Australasian Shoveler, Glossy Grass Skink, Peron's Tree Frog, Plains Froglet, Common Galaxias and Southern Pigmy Perch; riverine forest, River Red Gum grassy woodland, swamp scrub, Rush Sedge seasonal wetland and Many-fruit Tassel permanent wetland; faunal (particularly waterbirds and parrots) rarity, abundance and diversity and habitat rarity; riverine forest and red gum marshland critical conservation areas; and strategic habitat link between the upland hills and lowland volcanic plains (Plenty River Mernda to Yan Yean).

Key areas/physical features for biota

Towts Swamp, Dunnetts Road Swamp, Stagianos Lake, Mornmoot Lake, Brennans Forest/lower Barbers Creek and Plenty River.

4 sites of significance: 3 state and 1 regional for fauna and 2 high and 2 medium for habitat.

PUAP A GLENVALE

This management unit consists of one site of state faunal significance (site 37) and one of regional faunal significance (site 36) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7923 295528 to 7922 339470 (Bruces Creek) and 7922 342470 to 7923 362506 (Plenty River).
Location/Size: Floodplain of Bruces Creek and Plenty River West and East Branch between Whittlesea and the Hume Ranges of the Great Divide. Approximately 3400 ha.
Municipality: City of Whittlesea.

Physical Features

The management unit occurs on the alluvial plains of the Eastern Uplands. It occupies a large floodplain in the middle reaches of the Plenty River between the head of the Plenty Gorge and the foothills of the Great Dividing Range. The floodplain lies between the upfolded Whittlesea anticline to the west (hills running parallel to the Whittlesea–Wallan Road which separate the alluvial plains from the volcanic plains) and the uplifted basin forming the Kinglake Plateau of the Great Dividing Range to the east and north.

Landforms

Foothill (far north): hill-crests, hill-slopes and gullies. Alluvial plain: plain-slopes, valleys, drainage lines, creeks, river valley/alluvial floodplain, shallow freshwater marsh (Towts Swamp), farm lake (Mornmoot) and dams. Elevation is 190–320 m.

Hydrology

This unit contains a broad floodplain associated with Bruces Creek and Plenty River West and East Branches. It is similar to the Plenty River Yan Yean unit but is bordered more closely by steep hill-slopes of the Great Dividing Range. Before settlement the hill-slopes in the north contained fast-flowing streams. On reaching the alluvial plains, the water slowed down and the watercourses became ill-defined as they met with an extensive marshland (Whittlesea marshes) of the order of 1500 ha. This in combination with the Ryders Swamp downstream of Whittlesea formed a marshland area of over 3000 ha, by far the largest in NEM. The streams are no longer perennial due to upstream damming. Mornmoot Lake is a deep impoundment of 5 ha.

Towts Swamp is fed by local catchment and periodic flooding of Bruces Creek. The direct runoff mostly occurs in winter–spring after heavy rain in the catchment. On a ratio of about one in three years, apart from the main channel, the swamp is substantially dry by autumn. Every few years flash summer thunderstorms fill the swamp. On average over the year, water is at a high level for about four months, receding for four months and at a low level for four months. Towts Swamp contains a central drainage channel of permanent water (about 1 ha of 0.5 m depth at dry times). At high water this is surrounded by about 4 ha of shallow freshwater marsh at depth of less than 1 m. Surrounding freshwater meadows make up about 1 ha. The swamp contains greater numbers of waterfowl when it is high and greater numbers of waders when it is low.

Rainfall: 700–800 mm.

Site 36 Mornmoot Lake–Plenty River West Branch

Map Reference:	7923 335485 to 7923 322537 (Plenty River West Branch from the East Branch confluence to 500 m upstream of Bruces Creek Road); 7922 335484 to 7922 363505 (Plenty River East Branch from the West Branch confluence to 200 m downstream of Toorourrong Reservoir); 7923 295528 to 7923 307523 (Bruces Creek from upstream of Bruces Creek Road); 7923 332504 (Mornmoot Lake). One minute lat/long grids include 37° 27' x 145° 05' to 145° 06', 37° 28' x 145° 06' to 145° 07' and 37° 29' x 145° 06' to 145° 08'.
Location/Size:	Floodplains of the Plenty River East and West Branches upstream of their confluence and a short section of the Bruces Creek upstream of Glenvale. Approximately 340 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: nil. Private: farms and horse stud and beef cattle properties.
Landforms:	Elevation is 200–320 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Yellow Box–Candlebark grassy woodland (14.6); Common Tussock-grass–Tall Sedge seasonal wetland (25.5); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Blunt Pondweed (submerged herbfield) permanent wetland (26.1)

Remnant, degraded or establishing stands: ; Red Stringybark herb-rich foothill forest (6.1); Swamp Gum gully woodland (10.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Swamp Gum (floodplain) swampy woodland (27.1). Swamp Gum (creek) swampy riparian woodland (28.1); Yellow Box–Candlebark valley forest (31.1)

Rare species: Yarra Gum (creek by Jacks Creek Road)

Notable features: the field layer present under Yellow Box–Candlebark valley forest (31.1) along the narrow aqueduct reserve at Wildwood Road near the corner of Milky Lane is relatively intact.

FAUNAL SIGNIFICANCE: Site 36 Mornmoot Lake–Plenty River West Branch

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

36^a: 37° 27' x 145° 05'; Bruces Creek at Bruces Creek Road

36^b: 37° 27' x 145° 06'; Plenty River West Branch, Halls Road/Bruces Creek, Capstone Road

36^c: 37° 28' x 145° 06'; Mornmoot Lake Glenvale

36^d: 37° 29' x 145° 06'; Plenty River West Branch at Milky Lane

36^e: 37° 29' x 145° 07'; Plenty River East Branch at Milky Lane

36^f: 37° 29' x 145° 08'; Toorourrong–Yan Yean Aqueduct north of Milky Lane

36^g: 37° 29' x 145° 09'; Jacks Creek Road Humevale

36^h: 37° 30' x 145° 07'; Scrubby Creek/Plenty River at Whittlesea

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 36^c: Glossy Grass Skink, Mountain Galaxias. **36^{ab}:** Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 36^c: 27 species at Mornmoot Lake on 4 October 1988

d. Breeding waterfowl

Regional. 36^c: 5 species including the Australian Shelduck at Mornmoot Lake on 24 October 1988

k. Frogs

Regional. 36^c: 6 species at Mornmoot on 4 October 1988

l. Reptiles

Regional. 36^c: 5 species including the Glossy Grass Skink and Lowland Copperhead at Mornmoot on 4 October 1988

m. Freshwater fish (electrofishing survey)

Regional. 36^c: 4 species from West Branch upstream of Mornmoot on 25 January 1989 and 2 species at Mornmoot Lake on 25 January 1989

Regional. 36^a: 3 species from Bruces Creek at Bruces Creek Road on 24 January 1989

Regional. 36^b: 3 species from Bruces Creek at Capstone Road on 23 January 1989

Regional. 36^d: 3 species from West Branch at Milky Lane on 25 January 1989

Regional. 36^e: 3 species from East Branch at Milky Lane on 25 January 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 36^c: 53 species

c. Native mammals

Local. 36^c: 2 species

d. Herpetofauna

Regional. 36^c: 11 species

e. Freshwater fish

Regional. 36^c: 4 species. **36^{abde}:** 3 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 36^c: 16 species

b. Regionally endangered fauna (R1 species)

Regional. 36^c: 1 species. **Birds:** Plumed Whistling-Duck

c. Regionally vulnerable fauna (R2 species)

Regional. 36^c: 3 species. **Birds:** Spotless Crake, Azure Kingfisher. **Reptiles:** Glossy Grass Skink

d. Regionally rare fauna (R3 species)

Regional. 36^c: 7 species. **Birds:** Darter, Musk Duck, Pink-eared Duck, Australasian Shoveler, Hardhead. **Frogs:** Plains Froglet. **Fish:** Common Galaxias

Regional. 36^d: 2 species. **Frogs:** Plains Froglet. **Fish:** Common Galaxias

Regional. 36^e: 1 species. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 36^c: 5 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Regional. 36^{ab}: 2 species. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Local. 36^{deh}: 1 species. **Fish:** Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 36^c: 8 species. **Birds:** Pied Cormorant, Australian Pelican, Nankeen Night Heron, Cattle Egret, Australian Shelduck, Brown Songlark. **Mammals:** Water Rat. **Frogs:** Striped Marsh Frog

Local. 36^d: 1 species. **Frogs:** Striped Marsh Frog

Local. 36^e: 1 species. **Mammals:** Water Rat

Local. 36^h: 1 species. **Birds:** Great Egret

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 36^c: Latham's Snipe on the north-east side of Mornmoot Lake (11 on 4 October 1988 and 6 on 24 October 1988)

b. Rare or threatened fauna

Regional. 36^c: 50 Mountain Galaxias electrofished from the West Branch upstream of Mornmoot on 25 January 1989

g. Rare/restricted colonial fauna

Regional. 36^c: over 70 Cattle Egrets and 50 Little Pied Cormorants roosting at Mornmoot Lake on 4 October 1988

j. Electrofishing/netting rate (EF on 25.1.1989 unless otherwise stated)

Regional. 36^c: 458 fish (6 Short-finned Eel, 400 Common Galaxias, 50 Mountain Galaxias and 2 Southern Pigmy Perch) from the Plenty River West Branch about 200 m upstream of Mornmoot Lake; 65 fish (15 Short-finned Eel fyke netted and 50 Common Galaxias) from Mornmoot Lake

Regional. 36^d: 109 fish (5 Short-finned Eel, 100 Common Galaxias and 4 Southern Pigmy Perch) from Plenty River West Branch at Milky Lane

Regional. 36^e: 55 fish (2 Short-finned Eel, 3 Common Galaxias and 50 Southern Pigmy Perch) from Plenty River East Branch at Milky Lane

m. Regionally rare fauna (R3 species)

Regional. 36^c: 100 Plains Froglets at Mornmoot Lake on 4 October 1988; 400 Common Galaxias electrofished at Mornmoot Lake on 25 January 1989

Regional. 36^d: 100 Common Galaxias electrofished from the Plenty River West Branch at Milky Lane on 25 January 1989

n. Regionally depleted fauna (R4 species)

Regional. 36^c: 50 Southern Pigmy Perch electrofished from the Plenty River East Branch at Milky Lane on 25 January 1989

Outlook

Apart from waterbirds and freshwater fish at Mornmoot Lake, faunal values are declining. Streamway revegetation is required to reverse this trend. Over 95% of the indigenous habitat in the site is eliminated or degraded. The high regional values still achieved is a testimony to how biologically significant the area would have been before settlement.

FAUNA

Rare or Threatened Fauna

Bc 36^{abc}: Mountain Galaxias. Electrofishing survey: five from Bruces Creek at Bruces Creek Road on 24 January 1989, 1 in Bruces Creek at Capstone Road on 23 January 1989, one from Plenty River West Branch at Halls Road and 50 from Plenty River West Branch upstream of Mornmoot Lake on 25 January 1989. Habitat quality and flow of streams rapidly decline once they leave the ranges and enter the farmland. Despite bank slumping and stream channelling due to lack of native tree and shrub vegetation and access to livestock the Plenty River West Branch above Mornmoot

Lake contained running water and native riparian and instream herbfields of fair quality. Large populations of the Mountain Galaxias were present.

- Bc* **36^c: Glossy Grass Skink.** One recorded at Mornmoot Lake on 4 October 1988. Because floodplain woodlands and scrub have been cleared there are only remnant populations in the Plenty Upland Alluvial Plains. Ground debris required for cover by this skink is scarce. The populations may die out unless habitat is enhanced and streamway linkages are improved.

Other Significant Fauna

Birds

- Eb* **36^c: Plumed Whistling-Duck at Mornmoot Lake.** A pair was seen in Common Tussock-grass–Tall Sedge seasonal wetland (25.5) fringing the lake on 4 October 1988. This is the only sighting of the species during the Greater Melbourne survey. The pair were courting but were not present when the lake was revisited on 24 October 1988. Green grass at or away from the waters' edge forms the bulk of their diet at this time of year.
- Ec* **36^c: Spotless Crake at Mornmoot Lake.** One flushed from Common Tussock-grass–Tall Sedge seasonal wetland (25.5) into a bed of Common Reeds (seasonal wetland; 25.7) on 4 October 1988.
- Ec* **36^c: Azure Kingfisher at Mornmoot Lake.** The lake and nearby sections of the Plenty River West Branch form some of the most important water for native fish in the Plenty River system. Fish at Mornmoot Lake attract several species of waterbirds. These include the Azure Kingfisher, Darter, Nankeen Night Heron and Little Pied Cormorant, present on 4 October 1988. Australian Pelicans move between here, Towts Swamp and Yan Yean Reservoir in autumn–winter.
- Ed* **36^c: Musk Duck, Pink-eared Duck, Australasian Shoveler and Hardhead at Mornmoot Lake.** The Common Tussock-grass–Tall Sedge seasonal wetland (25.5) and Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7) fringing the shoreline and Blunt Pondweed (submerged herbfield) permanent wetland (26.1) in the lake are important for waterfowl. The lake contains deep water surrounding beds of Cumbungi near an island and submerged herbfields in the shallows. The following regionally rare waterfowl were recorded on 4 October 1988: 2 Musk Duck, 4 Pink-eared Duck, 1 Australasian Shoveler and 2 Hardhead. Pink-eared Duck have been recorded breeding (David Leighton pers. comm.).
- Five species of waterfowl were breeding at Mornmoot Lake on 24 October 1988: Australasian Grebe, Pacific Black Duck, Grey Teal, Chestnut Teal and Australian Shelduck. Mornmoot Lake is one of few breeding locations for the Australian Shelduck in NEM. The Grey Teal inhabits open water and has been replaced by Chestnut Teal in recent times at waterbodies that have become closed by vegetation. Other species potentially breeding include the Eurasian Coot, Hardhead and Australian Wood Duck.
- Ee* **36^c: Brown Quail, Buff-banded Rail and Latham's Snipe in the grassy margin of Mornmoot Lake.** Common Tussock-grass–Tall Sedge (floodplain herbfield) seasonal wetland (25.5) at the ungrazed margins of Mornmoot Lake provides important habitat for cover-dependent waterbirds. Eleven Latham's Snipe were seen on the north-eastern side on 4 October 1988 and six were present when revisited on 24 October 1988. The seasonal wetland contains up to 20 snipe each spring (David Leighton pers. comm.). The Latham's Snipe is a spring/summer migrant to Australia, breeding in Japan and China. Habitat of the Latham's Snipe in Australia is protected under the Jamba and Chamba treaties. The Brown Quail and Buff-banded Rail were seen on 4 October 1988. They both possibly breed at the lake.
- Fg* **36^c: Cormorant/egret roost at Mornmoot Lake.** The lake is used as a water reserve and irrigation supply and is not accessed by livestock. Resident populations of waterbirds are present. In winter–spring the scattered trees around the lake support over 200 roosting waterbirds (e.g. cormorants, ibis and Cattle Egrets). Over 70 Cattle Egrets and 50 Little Pied Cormorants were present on 4 October 1988.

Mammals

Ef **36^e: Water Rat.** One in Plenty River East Branch at Milky Lane on 25 January 1989. The loss of summer flow due to farm dams and bank damage, stream siltation and water contamination by livestock eliminated the Platypus in the 1970s. The dominant plant along the banks is White Crack Willow. Few other ground mammal species persist in the site.

Frogs

Ed **36^{cd}: Plains Froglet stronghold in NEM.** The Plains Froglet is widespread and locally common in sites 36 and 37. Over 100 were calling at Mornmoot Lake on 4 October 1988. The range of this inland species enters southern Victoria through the Kilmore Gap and is largely confined to the upland plains and hills of the Merri/Plenty catchment

Freshwater fish

Ed **36^{cde} Common Galaxias.** Mornmoot Lake contains an apparently land-locked population (John McKenzie & Bill O'Connor pers. comm.). It is the largest captive breeding population known in NEM. The electrofishing survey of 25 January 1989 recorded 400 from the Plenty River West Branch upstream of the lake, 100 from downstream of the lake and 50 from the lake. They were also recorded in the Plenty River East Branch. The lake possibly stocks much of the population present in the Plenty River system. Recent heavy rain had caused the lake and fish to overflow into the Plenty River West Branch. Common Galaxias normally migrate in autumn downstream to river estuaries to spawn. The design of the lake outlet prevents the next generation from returning (the installation of a fish-way would remedy this). Populations in the lake run upstream to spawn in spring. Sporting fish including Macquarie Perch have been stocked in the lake. The release of trout would cause a heavy decline in the population of Common Galaxias (and Mountain Galaxias upstream). The predatory Redfin is present. Downstream riparian habitat is degraded.

Ee **36^{abcdeg}: Southern Pigmy Perch.** This species can tolerate inferior water and riparian habitat quality and co-exist with alien fish more successfully than the Mountain Galaxias. It is still widespread in the streams and was recorded at most electrofishing sites. The Plenty River East Branch contains a substantial population of Southern Pigmy Perch. They breed in slack water pools created by willow roots. Without the willows, banks would collapse. Swamp Paperbark would provide a similar habitat and role in bank protection. The banks need fencing from livestock and replanting with native trees and shrubs. Then the willows should be poisoned, but left standing as they also provide nesting and roosting habitat for birds.

36^a: Electrofishing Survey: Plenty River–Bruces Creek at Bruces Creek Road

Map reference. 7923 307523. **Altitude.** 230 m. **Survey date.** 24 January 1989

Vegetation. Instream: submerged and emergent herbfield. **Bank:** Swamp Gum swampy riparian woodland (28.1).

Frontage: Swamp Gum swampy woodland (27.1); Yellow Box–Candlebark valley forest (31.1). The banks and frontage support only remnant native strata and are in poor condition with woody and grassy weeds.

Physical Features:**Pools**

Substrate. Silt and willow roots on alluvial clay base

Maximum size (mid-summer). 2.0 m wide by 1.5 m deep by 50 m long

Riffles

Substrate. Some cobbles and boulders on alluvial clay base

Flow (mid-summer normal): Size. 0.5 m wide by 2 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.5 ML/day

Water quality

Summer: Temperature. 21.0°C. **Conductivity.** 230 ms. **Turbidity.** Cloudy

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (3); migratory sub-adult. Mountain Galaxias (5); likely breeding resident. Southern Pigmy Perch (4); likely breeding resident

Alien species numbers/status. Nil.

36^b: Electrofishing Survey: Plenty River–Bruces Creek Glenvale at Capstone Road

Map reference. 7923 319519. **Altitude.** 220 m. **Survey date.** 23 January 1989

Vegetation. Instream: submerged and emergent herbfield (30% cover of algae). **Bank:** Swamp Gum swampy riparian woodland (28.1). **Frontage:** Yellow Box–Candlebark valley forest (31.1); Swamp Gum swampy woodland (27.1). The banks and frontage support only remnant native strata and are in poor condition with woody and grassy weeds.

Physical Features:

Pools

Substrate. Deep silt, logs and willow roots on alluvial clay base

Maximum size (mid-summer). 5.0 m wide by 1.2 m deep by 40 m long

Riffles

Substrate. Cobbles on alluvial clay base

Flow (mid-summer normal): Size. 0.5 m wide by 2 m deep. **Velocity.** 0.2 m/sec. **Rate.** 0.5 ML/day

Water quality

Summer: Temperature. 19.5°C. **Conductivity.** 330 ms. **Turbidity.** High

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (5); migratory sub-adult. Mountain Galaxias (1); likely breeding resident. Southern Pigmy Perch (25); likely breeding resident

Alien species numbers/status. Nil.

36^b: Electrofishing Survey: Plenty River–Plenty River West Branch at Halls Road

Map reference. 7923 325528. **Altitude.** 240 m. **Survey date.** 25 January 1989.

Vegetation. Instream: submerged and emergent herbfield. **Bank:** Swamp Gum swampy riparian woodland (28.1). **Frontage:** Swamp Gum swampy woodland (27.1); Yellow Box–Candlebark valley forest (31.1). The banks and frontage support only remnant native strata and are in poor condition with woody and grassy weeds.

Physical Features:

Pools

Substrate. Silt, logs and willow roots on alluvial clay base; log jams at downstream end of pools

Maximum size (mid-summer). 2.0 m wide by 0.5 m deep by 15 m long

Riffles

Substrate. Gravel and silt on alluvial clay base

Flow (mid-summer normal): Size. 1.0 m wide by 2 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 1.9 ML/day

Water quality

Summer: Temperature. 17.0° C. **Conductivity.** 100 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Mountain Galaxias (1); likely breeding resident

Alien species numbers/status. Nil.

36^c: Electrofishing Survey: Plenty River–Plenty River West Branch upstream of Mornmoot Lake

Map reference. 7923 331507. **Altitude.** 220 m. **Survey date.** 25 January 1989

Vegetation. Instream: submerged and emergent herbfield (10% cover of algae). **Bank:** Swamp Gum swampy riparian woodland (28.1). **Frontage:** Yellow Box–Candlebark valley forest (31.1); Swamp Gum swampy woodland (27.1). The banks and frontage support only remnant native strata and are in poor condition with woody and grassy weeds.

Physical Features:

Pools

Substrate. Silt and willow roots on alluvial clay base

Maximum size (mid-summer). 1.3 m wide by 0.4 m deep by 10 m long

Riffles

Substrate. Gravel and silt on alluvial clay base

Flow (mid-summer normal): Size. 0.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 2.4 ML/day

Water quality

Mid-summer normal: Temperature. 21.0°C. **Conductivity.** 118 ms. **Turbidity.** Clear
Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (6); migratory sub-adult. Mountain Galaxias (50); likely breeding resident. Common Galaxias (400); likely breeding resident. Southern Pigmy Perch (2); likely breeding resident

Alien species numbers/status. Redfin (20); likely breeding resident in the lake. Mosquito Fish (2); likely breeding resident in the lake and slackwater pools of the creek.

36^c: Electrofishing Survey: Plenty River–Mornmoot Lake

Map reference. 7923 331503. **Altitude.** 210 m. **Survey date.** 25 January 1989

Vegetation. Aquatic: Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) and Blunt Pondweed (submerged herbfield) permanent wetland (26.1). Frontage: Common Tussock-grass–Tall Sedge seasonal wetland (25.5). The original creekbank and frontage forest/woodland has been eliminated. This would have included Swamp Gum swampy riparian woodland (28.1), Yellow Box–Candlebark valley forest (31.1) and Swamp Gum swampy woodland (27.1). Some trees and shrubs have been planted around the lake, most of which are non-indigenous. Weeping Willow is the dominant tree.

Physical Features:

Pools

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). Irrigation impoundment on the Plenty River West Branch

Riffles and flow: N/A.

Water quality

Summer: Temperature. 23°C. **Conductivity.** 160 ms. **Turbidity.** Moderate

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (15); migratory sub-adult. Common Galaxias (50); likely breeding resident

Alien species numbers/status. Redfin (12); likely breeding resident. Goldfish (1); likely breeding resident.

36^d: Electrofishing Survey: Plenty River–Plenty River West Branch at Milky Lane

Map reference. 7923 333495. **Altitude.** 200 m. **Survey date.** 25 January 1989

Vegetation. Instream: submerged and emergent herbfield. Bank: Swamp Gum swampy riparian woodland (28.1). Frontage: Yellow Box–Candlebark valley forest (31.1); Swamp Gum swampy woodland (27.1). The banks and frontage support only remnant native strata and are in poor condition with woody and grassy weeds.

Physical Features:

Pools

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). 4.0 m wide by 0.8 m deep by 20 m long

Riffles

Substrate. Silt and sand on alluvial clay base

Flow (mid-summer normal): Size. 0.5 m wide by 2 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.5 ML/day

Water quality

Summer: Temperature. 22°C. **Conductivity.** 135 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (5); migratory sub-adult. Common Galaxias (100); overflow population from Mornmoot Lake and possibly some passage migrants; unlikely breeding in the shallow pools and ephemeral riffles of the creek. Southern Pigmy Perch (4); likely breeding resident

Alien species numbers/status. Redfin (24); overflow population from Mornmoot Lake; unlikely to be breeding in the shallow pools and ephemeral riffles of the creek.

36^e: Electrofishing Survey: Plenty River–Plenty River East Branch at Milky Lane

Map reference. 7923 340494. **Altitude.** 200 m. **Survey date.** 25 January 1989.

Vegetation. Instream: submerged and emergent herbfield (50% cover of algae). Bank: Swamp Gum swampy riparian woodland (28.1). Banks support only remnant native strata and are in poor condition with woody and grassy weeds. Frontage vegetation of Yellow Box–Candlebark valley forest (31.1) and Swamp Gum swampy woodland (27.1) has been cleared.

Physical Features:

Pools

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). 8.0 m wide by 1.5 m deep by 20 m long

Riffles

Substrate. Silt and sand on alluvial clay base

Flow (mid-summer normal): Size. 1.0 m wide by 2 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.95 ML/day

Water quality

Summer: Temperature. 19.5°C. **Conductivity.** 180 ms. **Turbidity.** Very high

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (2); migratory sub-adult. Common Galaxias (3); passage migrant. Southern Pigmy Perch (50); likely breeding resident

Alien species numbers/status. Nil.

36^h: Electrofishing Survey: Plenty River–Scrubby Creek at Whittlesea showgrounds

Map reference. 7922 349468. **Altitude.** 200 m. **Survey date.** 14 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank and frontage tree/shrub strata have been eliminated. These would have consisted of Swamp Gum swampy riparian woodland (28.1), Yellow Box–Candlebark valley forest (31.1) and Swamp Gum swampy woodland (27.1). Banks are in poor condition and invaded by woody and grassy weeds.

Physical Features:

Pools

Substrate. Deep silt on alluvial clay base

Maximum size (mid-summer). 5.0 m wide by 1.2 m deep by 20 m long

Riffles

Substrate. Silt and sand on alluvial clay base

Flow (mid-summer normal): Size. 0.5 m wide by 5 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 1.2 ML/day

Water quality

Summer: Temperature. 22°C. **Conductivity.** 330 ms. **Turbidity.** High

Fish Recorded During Survey

Native species numbers/status. Southern Pigmy Perch (2); likely breeding resident

Alien species numbers/status. Nil.

Comments: poor water and habitat quality. The pigmy perch would be under stress and populations are very low.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. The site is heavily cleared. A relatively intact habitat link occurs north of Halls Road to the Falls Creek site. Highly fragmented links occur along the Plenty River West Branch to the Plenty River East Branch and upstream along the East Branch to Toorourrong Reservoir.</p>	
<p>Habitat loss and fragmentation. The wetlands of Plenty Upland Alluvial Plains are now fragmented through land clearing and draining. The Plenty River West and East Branch and Bruces Creek upstream of Whittlesea have been severely degraded by clearing of native riparian and catchment vegetation, the spread of alien plant species and by domestic stock contaminating the water and damaging the banks .</p>	<p>Strengthen habitat links. See Regional Hydrological Strategy below.</p>
Regional Hydrological Strategy	
<p>Loss of perennial stream flow. There is inadequate flow of water coming from the forested catchments to flush out the nutrient and silt-enriched runoff from paddocks in the local catchment. The once perennial and fast-flowing Bruces Creek and Plenty River Branches have been reduced to strings of muddy puddles in summer–autumn.</p>	<p>Improve flow rates of streams. There is need to restore stream flows in summer–autumn. Many of the old large dams which were part of larger properties are not fully utilised on small farms and remain full over summer. There needs to be some water released from a network of the dams at critical low stream flow periods to flush out stagnating pools. A recommendation of the Regional Hydrological Strategy is that the proliferation of dams (especially large dams) on hobby farms be reviewed.</p>
<p>Declining water quality and habitat degradation of the Plenty River West and East Branch. Pools stagnate and overheat during summer, causing eutrophication as algal blooms deplete the water of oxygen. The effect of superphosphate, insecticides and herbicides that have been widely used locally on the stream fauna is unknown. They are likely to have been severe, given already that species such as the Platypus have been eliminated.</p>	<p>Indigenous revegetation program and land protection works along streams. These still support significant faunal species, particularly native fish (McKenzie 1989). There is potential under habitat protection works to greatly improve faunal values of the streams. This requires the formulation of guidelines for the improvement of vegetation links along the Plenty River East and West Branches and Bruces Creek. Banks along these streams should be fenced from livestock. This would enable the commencement of native revegetation programs to restore habitat links and improve the water quality.</p>

Plenty River West Branch at Milky Lane.

Mornmoot Lake has substantially reduced the downstream flow of the Plenty River West Branch. Flow only occurs when the lake overflows. For most of summer–autumn the riffles are dry and the pools, which are shallow, stagnate. Riparian and frontage vegetation has been heavily cleared from this section of the stream. Only scattered trees remain as livestock grazing has prevented regeneration.

Indigenous revegetation program and habitat creation at Mornmoot Lake.

The lake is fenced from stock and contains a large island roost area and refuge for waterbirds. The establishment of willows and planted trees has created habitat for wildlife. The shelterbelts provided by existing plantings also benefit the livestock. Planting with indigenous eucalypts and Swamp Paperbarks and the provision of platforms for ducks and possibly cormorants to nest on should be promoted. These in combination with fencing of a wider section surrounding the lake for seasonal wetland revegetation would promote the breeding of seasonal visitors such as the Australasian Shoveler and Hardhead. It may also recruit rare waterfowl such as the Blue-billed Duck and cover-dependent crakes, bitterns and rails. An increase in the availability of nesting habitat and cover and a degree of protection from foxes could raise the faunal significance of the wetland for waterbirds and breeding waterfowl to the State level.

Establishment of a fish-way at Mornmoot Lake.

This should be investigated so as to enable the movement of migratory fish up the stream. There is a recommendation under the Regional Hydrological Strategy (see Volume 1) for fish-ways at all instream dams of major streams in NEM.

Electrofishing sites

Bruces Creek at Capstone Road. Steep eroding banks. The loss of bank vegetation and resultant erosion is due to livestock grazing as there is an inadequate fencing setback from the creek. Nutrient-enriched water has promoted algal growth.

Plenty River West Branch upstream of Mornmoot Lake. Stock gain access from the east side of the stream and wade in the water and trample the stream bed and banks. This has caused severe loss of bank vegetation and bank slumping and erosion, causing considerable damage to the important fish breeding habitat present. The creek and its frontage are severely lacking in native trees and shrubs. This has caused the channel to become scoured by the relatively fast-moving water. Redfin, which were stocked in Mornmoot Lake along with Macquarie Perch, are food competitors and voracious predators of the native pigmy perch and galaxias. This may account for the absence of the pigmy perch from the lake and presence of only small numbers in the creek.

Willows need to be replaced by native riparian vegetation.

Plenty River West Branch upstream of Mornmoot Lake. This section, despite lacking adequate native riparian vegetation, contained the most significant fish fauna in the Plenty River West Branch. This is largely due to the relatively high water quality and natural flow rate entering from upstream. The site is only a short distance across farmland to mountain forests and there are few large intervening dams in the farmland catchment. The water quality and flow rate deteriorates rapidly downstream of Mornmoot Lake. The section requires revegetation of the streamway.

Mornmoot Lake. Outflow of the lake is a gushing pipe about 0.5 m above the ground. This prevents upstream passage of migrating fish with the exception of eels which can cross overland. Common Galaxias are unable to complete their return migration from the sea to breeding grounds upstream of the lake. They probably perish in the downstream section of the Plenty River West Branch but a land-locked breeding population has established in the lake. Redfin appear to have eliminated Southern Pigmy Perch from the lake. Closs (1984) found that these two species are direct food competitors in the Plenty River. Large Redfin also prey on pigmy perch.

Plenty River East Branch at Milky Lane. The section is degraded and native vegetation has been cleared. The flow rate of the East Branch below Toorourrong Reservoir, until the junction with the West Branch and Scrubby Creek at Whittlesea, is chronically low during summer–autumn. Native fish are reliant on the presence of White Crack Willow for shade and cover. Farm management along the East Branch has allowed stock access along most of the stream. Nutrient levels (e.g. due to stock faeces) in the pools are apparently high. The water is stagnant and has undergone eutrophication. Platypus were eliminated in the 1970s due to declining water quality and lack of flow from the Toorourrong Reservoir. It is now unlikely that breeding animals from Toorourrong and the Plenty Gorge come into contact.

Plenty River West Branch at Milky Lane. Aquatic vegetation and water quality of the stream is fair but the banks are degraded and the frontage vegetation is cleared. The mature Redfin and Common Galaxias were likely to have washed out from Mornmoot Lake during a recent rainstorm. The galaxias would probably not breed downstream of the lake due to inadequate water flow.

Scrubby Creek at Whittlesea Showgrounds. The creek is polluted by runoff from the northern outskirts of Whittlesea and possibly septic tank leachate from Humevale. The flow rate of Scrubby Creek has declined to about 50% of that at Humevale due to pumping and farm dams.

Mornmoot Lake. Disruption or depletion of natural flow in most of the waterways of NEM is a major item in need of address in the Regional Hydrological Strategy. The future construction of instream dams in major waterways should not be approved unless subjected to a full study of hydrological and environmental effects. An effective fish-way should be provided in the design. Mornmoot Lake and the section of the West Branch immediately upstream would appear critical to the survival of Common Galaxias in the Plenty River system. The lake has disrupted the migratory movements of freshwater fish in the Plenty River West Branch. Given the recent establishment of a fish-way at Dights Falls, another fishway at Mornmoot Lake may enable return migration of the Common Galaxias.

Plenty River West Branch at Milky Lane. This section of the stream should be a primary target of the Plenty River Habitat Link Strategy. It requires land protection and revegetation works. The release of some water from Mornmoot Lake into the stream during critical low summer–autumn flow periods would be beneficial for native fish.

Other Issues

Mowing the grassy verge of the Toorourrong—Yan Yean Aqueduct. Management by Melbourne Water requires the grassland verges of the aqueduct to be mowed for fire prevention in late spring (the flowering time of several orchid species present). This practice is threatening the significant orchid assemblage on the aqueduct. Adjacent paddocks are heavily grazed and the narrow strip of grassland along the aqueduct presents little (if any) fire hazard. In the absence of mowing the tussock grass layer will become dense and likely shade out the inter-tussock herbs (e.g. orchids).

The inter-tussock herbs (e.g. orchids). Long-term management of these herbs would require intermittent burning.

Site 37 Towts Swamp

Map Reference:	7923 321490. One minute lat/long grids include 37° 29' x 145° 06'.
Location/Size:	Towts Swamp and surrounding floodplain, 3 km north-west of Whittlesea. Approximately 15 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: nil; apart from the Wallan–Whittlesea Road frontage. Private: farm/wetland.
Landforms:	Elevation is 200–210 m.

Natural Heritage Values

Landscape. Towts Swamp is one of few extensive, representative and relatively intact shallow freshwater marshes remaining in NEM. It is the largest remnant of a formerly extensive series of spike-sedge marshes on the floodplains of the Plenty River upstream of Whittlesea. Shallow freshwater marshes have been greatly affected by drainage and grazing in Victoria (Andrew Corrick pers. comm.).

Scientific and Educational Values

Invertebrates. There is an early collection of the endangered (and presumed regionally extinct) Hemiphysalis Damsselfly (*H. mirabilis*) from the Whittlesea swamps. This species inhabited the spike-sedge and paperbark swamps of the southern lowlands and the Goulburn River valley. These areas have been drastically cleared and drained for farmland, dammed or modified by land settlement (Corrick 1984). The damsselfly appears poorly adapted to habitat loss and degradation caused by land clearing, altered swamp hydrology due to draining or rapid climatic change (as predicted under Greenhouse). It is now known only to occur at Wilsons Promontory. This species bears a number of reduced and primitive characters including the larval morphology and wing venation of ancestral 'Gondwanaland fauna' species (CSIRO 1991).

Rehabilitation and management. Towts Swamp is a listed Land for Wildlife area.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Relatively intact and extensive stands: Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Blunt Pondweed (submerged herbfield) permanent wetland (26.1)

Partially intact or small stands: Common Tussock-grass–Tall Sedge seasonal wetland (25.5)

Remnant, degraded or establishing stands: Swamp Gum swampy woodland (27.1); Swamp Gum (creek) swampy riparian woodland (28.1); Yellow Box–Candlebark valley forest (31.1)

Notable features: see Landscape. The swamp fringe would have originally contained Swamp Paperbark.

FAUNAL SIGNIFICANCE: Site 37 Towts Swamp

Assessment: State—Category 2 (B, C, E); Regional (C, D, E, F)

Reference grids for the significance keys include:

37^a: 37° 29' x 145° 06'; Towts Swamp Glenvale

A. Cited Zoological Significance

Regional. Glenvale Wetlands: Beardsell (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. **37^a:** Baillon's Crane, Painted Snipe, Little Bittern, Australasian Bittern, Blue-billed Duck

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

a. International migratory waders

Regional. 37^a: 3 species on 24 February 1986: Greenshank, Red-necked Stint and Sharp-tailed Sandpiper; 3 species on 23 March 1988: Marsh Sandpiper, Red-necked Stint and Sharp-tailed Sandpiper

b. Waterbirds

State. 37^a: 50 species recorded during the 1986–96 survey period

Regional. 37^a: 26 species on 23 March 1988 and 22 species on 24 February 1986

d. Breeding waterfowl

Regional. 37^a: 6 species on 29 September 1988: Black Swan, Pacific Black Duck, Hardhead, Grey Teal, Chestnut Teal and Eurasian Coot

k. Frogs

Regional. 37^a: 7 species including the Plains Froglet, Growling Grass Frog and Striped Marsh Frog on 15 November 1988

m. Freshwater fish

Regional. 37^a: Short-finned Eel and Southern Pigmy Perch on 24 January 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 37^a: 86 species

c. Native mammals

Local. 37^a: 1 species (Water Rat)

d. Herpetofauna

Regional. 37^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 37^a: 30 species

b. Regionally endangered fauna (R1 species)

Regional. 37^a: 3 species. **Birds:** Marsh Sandpiper, Painted Snipe, Intermediate Egret

c. Regionally vulnerable fauna (R2 species)

State. 37^a: 12 species. **Birds:** Crested Pigeon, Baillon's Crake, Spotless Crake, Black-winged Stilt, Greenshank, Red-necked Stint, Sharp-tailed Sandpiper, Whiskered Tern, Little Egret, Little Bittern, Australasian Bittern, Spotted Harrier

d. Regionally rare fauna (R3 species)

State. 37^a: 8 species. **Birds:** Australian Spotted Crake, Darter, Red-kneed Dotterel, Hardhead, Pink-eared Duck, Australasian Shoveler, Blue-billed Duck. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 37^a: 7 species. **Birds:** Latham's Snipe, Swamp Harrier, Peregrine Falcon, Australian King-Parrot, Rainbow Bee-eater. **Reptiles:** Red-bellied Black Snake. **Fish:** Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 37^a: 10 species. **Birds:** Pied Cormorant, Australian Pelican, Great Egret, Cattle Egret, Royal Spoonbill, Australian Shelduck. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 37^a: 15 birds of 3 species on 24 February 1986: 8 Sharp-tailed Sandpiper, 6 Red-necked Stint and 1 Greenshank

c. Waterfowl

Local. 37^a: 46 of 9 species on 23 March 1988

f. Frogs

Regional. 37^a: more than 50 each of the Plains Froglet, Common Bullfrog and Growling Grass Frog on 15 November 1988

j. Electrofishing or netting rate

Regional. 37^a: 100 Southern Pigmy Perch on 24 January 1989

k. Regionally endangered fauna (R1 species)

Regional. 37^a: 5 Intermediate Egret on 24 February 1986

l. Regionally vulnerable fauna (R2 species)

Regional. 37^a: 5 Sharp-tailed Sandpiper on 23 March 1988; 8 Sharp-tailed Sandpiper and 6 Whiskered Tern on 24 February 1986

m. Regionally rare fauna (R3 species)

Regional. 37^a: 6 Hardhead on 17 December 1986; 5 Pink-eared Duck on 23 March 1988; 50 Plains Froglet on 15 November 1988

n. Regionally depleted fauna (R4 species)

Regional. 37^a: 100 Southern Pigmy Perch on 24 January 1989

Outlook

Due to cover loss from livestock grazing over recent years the biological values of the swamp have declined.

FAUNA

Rare or Threatened Fauna

Bc 37^a: Painted Snipe at Towts Swamp. The swamp is a shallow freshwater marsh with fringing and emergent sedge brakes, patches of open ground and mudflats and surrounding grassland. This is the favoured habitat of the Painted Snipe which is a rare and sporadic spring–summer visitor from inland eastern Australia. A single bird was flushed from Common Tussock-grass–Tall Sedge seasonal wetland (25.5) along the south-eastern shoreline on 4 October 1988. This was the first observation in NEM during the 1986–96 survey period. The only other observation was at Wilton Vale Marsh in Plenty Gorge Park (site 40) on 1 January 1996.

Birds seen in GM possibly represent post-breeding dispersal of juveniles after the subtropical wet season (March–May). Irregular influxes occur onto the alluvial and volcanic plains, particularly the coastal districts of the Werribee Plains (various quail shooters pers. comm.). An influx occurred during an inland drought in 1977 and the following year, which was wet in southern Victoria. The population, which had built up during the bountiful inland breeding seasons of the big floods of 1974–75, left for the southern coast. They arrived in late autumn 1977, but had gone by early spring as local conditions dried out. They returned again in 1978 and remained for the wet spring to breed (various snipe shooters pers. comm.). Following on the drought of 1967–68, a large influx and extensive breeding episode occurred in 1970. This was a very wet year locally with high spring floodwaters.

Only a half dozen Painted Snipe were recorded during the fauna surveys of GM over the last decade. Each was a solitary bird (though sometimes in the vicinity of Latham's Snipe). They are also rare in the historical record (e.g. Laverton in 1897 and 1951). Documented breeding is mainly confined to the Murray–Darling system of inland eastern Australia (Blakers *et al.* 1984). However, some interviewed snipe shooters have observed breeding birds in the

1960s/70s on the volcanic plains west of Melbourne. It would appear that they are opportunist breeders and loose nesting colonies develop in spring floodwaters in influx years. The nest is a grass-lined scrape in a raised mound or island of dry mud amongst grass tussocks or rushes, surrounded by shallow water (Readers Digest 1986). Nests can be placed on shorelines, small islands and banks of channels (Lane & Davies 1987). The female is polyandrous (mates with several males) and nest building, incubation and rearing of young is conducted by the less brightly coloured male.

Painted Snipe are mostly nocturnal and feed by skulking like a rail. They rest in camouflage by day amongst grass or rush cover. They probe in soft mud and shallow water near cover for aquatic insects, snails and crustaceans and peck grasshoppers, worms and some herbage and seeds from the grass and litter (Reader's Digest 1986). The Painted Snipe is now very rare in GM. It appeared formerly to be more common in Victoria but over recent decades numbers have declined. Interviews with long-time shooters suggest its decline is due to a combination of increased stocking rates causing loss of cover plus trampling of mudflats and the clearing of suitable habitat. Many of its former favoured haunts such as the Whittlesea to Glenvale swamp floodplains have all but disappeared.

Bc **37^a: Baillon's Crake, Little Bittern and Australasian Bittern at Towts Swamp.** Single birds of each species were recorded in Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7). The Baillon's Crake was observed on 25 February 1989. The Little Bittern was observed on 24 February 1987. The Australasian Bittern was observed in 1990 (Alan Webster pers. comm.).

Bc **37^a: Blue-billed Duck at Towts Swamp.** Pair in Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) on 25 February 1989.

Critical Assemblages or Populations

Bc **37^a: Most diverse assemblage of waterbirds in NEM.** Fifty species were recorded between 1986 and 1990. Along with the Morang Wetland in Plenty Gorge Park (site 40), this is the most diverse waterbird assemblage recorded in NEM. It includes 12 species of waterfowl most of which are seasonal visitors (e.g. 6 Hardhead on 17 December 1986 and 5 Pink-eared Duck on 23 March 1988). The most waterfowl seen on one day at the swamp was 46 individuals of nine species on 23 March 1988. The extensive and intact aquatic herbfield and muddy substrate at Towts Swamp is utilised by the most diverse assemblage of rare or threatened seasonally visiting wader species known at any single wetland in NEM. The most significant include:

- Four species listed rare or insufficiently known in Victoria: Baillon's Crake, Painted Snipe, Little Bittern, Australasian Bittern
- Five international migratory species: Latham's Snipe, Greenshank, Red-necked Stint, Marsh Sandpiper, Sharp-tailed Sandpiper
- Four regionally threatened species: Spotless Crake (1 on 24 February 1987), Intermediate Egret (5 on 24 February 1986), Little Egret (several autumn sightings) and Black-winged Stilt (1 on 24 February 1986; summer–autumn visitor).

The value of Towts Swamp for waterbirds is not only its floristic and habitat diversity and intactness but the inundation and ebbing regime over the undulating topography. In recent years it has been grazed more heavily by cattle and these values have declined. The floor of the swamp is a series of channels and mudbars. As the water recedes during summer it exposes herbfields amongst extensive areas of drying mudflats. When visited between 1986 and 1988 Towts Swamp was the most important spike-sedge dominated swamp for waterbirds remaining in NEM.

In the mid-1980s the spike-sedge and Water-ribbons provided extensive cover. At this time, greater diversity and numbers of waterbirds were present. Being close to disturbance from the Wallan–Whittlesea Road, the vegetation provided essential cover. There were more waterfowl such as the Blue-billed Duck and Australasian Shoveler and more snipe and crakes when tall cover was present. The cover supported greater populations of frogs, fish and invertebrate prey. It attracted larger numbers of herons, spoonbills and cormorants, along with waterfowl. Other species such as the sandpipers, Australian Pelican, Whiskered Tern, Swamp Harrier and Darter visited seasonally.

Other Significant Fauna

Birds

Ec **37^a: International migratory waders.** Towts Swamp is one of only two wetlands (along with Staglanos Lake at Yan Yean) in NEM which support several international migratory wader species. Both contain bare mudflats, islands and mudbars at low water and extensive areas of vegetated shallows at high water. During the summer–autumn water drawdown, extensive mudflats become exposed.

The sandpipers migrate to Australia from their breeding grounds in the northern hemisphere. They arrive at coastal and near coastal wetlands in GM in late August–early September, leaving in late March–early April. Small numbers annually visit the drying waterbodies of the Plenty Alluvial Plains from mid-February to late March, prior to their return migration. They are usually seen singly (e.g. Greenshank and Marsh Sandpiper) or in small groups (e.g. Sharp-tailed Sandpiper and Red-necked Stint).

The largest group seen in recent years was of 15 birds on 24 February 1986 at Towts Swamp (8 Sharp-tailed Sandpipers, 6 Red-necked Stints and 1 Greenshank). On the same day these three species were also seen at Staglanos Lake (site 39). Two Red-necked Stints and five Sharp-tailed Sandpipers were present at Towts Swamp on 23 March 1988. A single Marsh Sandpiper was also present on this occasion. Only five other observations of this regionally endangered species were made in GM. These were at near coastal wetlands of Port Phillip Bay and freshwater marshes on the Werribee Plains.

The Red-necked Stint forages mostly above the water line pecking its food from the wet or drying mudflat surface or rapidly jabbing into the substrate (Lane & Davies 1987). The Sharp-tailed Sandpiper probes in the shoreline mudflats and from within the edge of the shallows. They also peck from the water surface. The food of these two waders in freshwater consists of tiny aquatic invertebrates such as worms, freshwater shrimps, shell-shrimps (ostracods), gastropod molluscs, beetles and insect larvae such as midges (Blakers *et al.* 1984, Lane & Davies 1987). The Greenshank jabs and probes for aquatic invertebrates such as crustaceans and insect larvae in the muddy substrate and chases fish while wading in the shallows (Blakers *et al.* 1984).

Each summer, the western shores of Port Phillip Bay hold up to 65 000 migratory waders (the bulk of which are the sandpipers), making it the sixth most important area for these birds in Australia (Lane *et al.* 1984). It contains sites that are internationally or nationally significant for waders and waterfowl (Schulz *et al.* 1991). Coastal feeding grounds in GM have been substantially reduced by industrial, commercial and residential development and are undergoing heavy human recreational pressure (Schulz *et al.* 1991). Shallow freshwater marsh habitat for sandpipers in NEM has been destroyed or degraded by clearing and draining for settlement and livestock grazing.

37^a: Birdlist for Towts Swamp. A detailed birdlist containing 61 native species was provided by the owner, Margaret Towt of Glenvale. Significant species on the list include the Crested Pigeon, Pied Cormorant, Australian Pelican, Red-necked Stint, Royal Spoonbill, Great Egret, Cattle Egret, Little Egret, Red-kneed Dotterel, Australian Shelduck, Hardhead, Pink-eared Duck, Australasian Shoveler, Blue-billed Duck and Swamp Harrier.

Magpie Goose. Kearland (1900) wrote that the Whittlesea swamps were a prime area for the Magpie Goose. Natural populations no longer occur in southern Victoria. Remnant populations still inhabit Tall Spike-sedge swamps in the New South Wales Riverina.

Frogs

37^a: Growling Grass Frog. The still water of Towts Swamp with its extensive emergent and submerged vegetation and grassy margins forms prime habitat for the Growling Grass Frog. Over 50 were heard calling on 15 November 1988. Depletion of native herbfield vegetation in recent years by livestock grazing at Towts Swamp has reduced the cover and invertebrate food availability. Cover loss may be critical as excessive levels of UV radiation and desiccation may kill developing Growling Grass Frog embryos. Adults have been seen crossing Wallan Road opposite the swamp in search of crickets and grasshoppers on warm, rainy nights.

Freshwater fish

Ee **37^a: Southern Pigmy Perch.** When electrofished in January 1989 while full, Towts Swamp supported the highest population density of Southern Pigmy Perch recorded in NEM (McKenzie 1989). The combination of clear water, extensive Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7), Blunt Pondweed (submerged herbfield) permanent wetland (26.1) and muddy substrate is ideal for the pigmy perch.

37^a: Electrofishing Survey: Plenty River–Towts Swamp

Map reference. 7923 321490. **Altitude.** 200 m. **Survey date.** 24 January 1989

Vegetation. Aquatic: Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) and Blunt Pondweed (submerged herbfield) permanent wetland (26.1). Frontage: Common Tussock-grass–Tall Sedge seasonal wetland (25.5). The original frontage woodland has been eliminated. This would have included Yellow Box–Candlebark valley forest (31.1) and Swamp Gum swampy woodland (27.1). Indigenous trees and shrubs have been planted on an island in the swamp.

Physical Features:**Pools**

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). N/A (4 ha waterbody)

Riffles and flow: N/A

Water quality

Summer: Temperature. 29.0°C. **Conductivity.** 700 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (2); migratory sub-adult. Southern Pigmy Perch (100); large population; likely breeding resident

Alien species numbers/status. Goldfish (2); likely breeding resident.

MANAGEMENT

Threatening Processes	Conservation Measures:
Regional Habitat Link Strategy	
Habitat connectivity. No intact habitat links remain. A fragmented link exists upstream along Bruces Creek to the Upper Plenty site.	
Regional Hydrological Strategy	
Bruces Creek should come under a comparable hydrological strategy and plan of management to that suggested for the Plenty River West Branch at Mornmoot Lake.	
Loss and degradation of wetlands on the Glenvale plains. Most of the shallow freshwater marsh habitat on the Glenvale plains (and in the remainder of NEM) has been destroyed or degraded by clearing, draining and livestock grazing.	

Mosquito Fish. The potential for Mosquito Fish to invade Towts Swamp is high as they are present in the adjacent section of Bruces Creek. In the creek they have limited, if not prevented, successful recruitment of many species of frogs. The near-surface feeding Mosquito Fish eat floating egg-masses (and other spring–summer breeding frogs of the genus *Litoria* and *Limnodynastes*) and nibble the fins of later stage tadpoles, often causing them to drown. Natural predators of the tadpoles and egg-masses include waterbirds, tortoises, fish and carnivorous aquatic insects such as damselfly and caddis-fly larvae and water beetles.

Electrofishing site–Towts Swamp. Major threats are substrate damage and cover loss caused by cattle grazing and the release of European Carp in the large dam upstream of the swamp. The dam overflows into the swamp and the establishment of carp presents a threat to the pigmy perch population because of the loss of aquatic cover. Towts Swamp may have originally contained Swamp Paperbark swamp scrub (17.1). This and the surrounding grassy woodland/swampy woodland (14.6/27.1) has been eliminated between Whittlesea and Glenvale. The water temperature of the swamp was particularly high. The lack of fringing trees and shrubs and removal of aquatic vegetation from the shallows by livestock contribute to this. The relatively high water conductivity (and likely salinity) is indicative of floodplain swamps, as these act as discharge areas for salt and settling areas for silt. The cleared, eroding hills in the catchment of the swamp south of Glenvale would be a major source of salt and silt. Until being grazed in recent years, the submerged meadows of the swamp kept the water from becoming turbid.

The effects of cattle grazing at Towts Swamp:

1. Depletion of waterbird, frog and fish habitat.

Grazing cattle on aquatic vegetation at swamps is a traditional farming practice. This has contributed to the loss of wetland vegetation in the Whittlesea swamps. It is not a recommended procedure for wetland conservation. Grazing at Towts Swamp is compacting and pugging the mudflats when they are soft during spring. The cover of emergent vegetation has been reduced by about 50% since the swamp was first surveyed in 1986. The turbidity level of the water has noticeably increased. Short grass around the edge and open water provides sub-optimal habitat for rare cover-dependent waterbirds such as snipe, bitterns and crakes. Emergent vegetation is the feeding and breeding habitat of these species. Common and widespread waterbirds remain (Pacific Black Duck, Australasian Grebe, Yellow-billed Spoonbill, Little Pied Cormorant and White-faced Heron), but several of the rarer birds probably no longer visit.

Summer grazing is limiting the establishment of fringing semi-aquatic species such as Common Tussock-grass and aquatic species such as Water-ribbons and Tall Spike-sedge. As the swamp dries, cattle trawl the vegetation as they walk along the mudbars or wallow in the channels. They uproot the Water-ribbons for fleshy tubers (food of species such as the Eastern Swamphen) and have eliminated the Common Nardoo. On several occasions cattle have been observed eating the platforms of Black Swans while the birds were nesting.

2. Lowered wetland invertebrate diversity. With the depletion of vegetation cover, important food chain invertebrates and their predators such as the Growling Grass Frog and Striped Marsh Frog appear to have declined. The invertebrates in Towts Swamp fall into three broad trophic level feeding groups. These are the detritivores or decomposers (midge larvae, scorpion-fly larvae, amphipods and ostracods), the herbivores (moth larvae, molluscs, microcrustaceans, caddis-fly larvae and bugs) and the carnivores (predators—water beetles and damselfly larvae; scavengers—rove beetles and freshwater crayfish; and parasites—mosquitos and scorpion-flies). Each are dependent on submerged, emergent and fringing herbfield cover and each forms important prey for waterbirds, pigmy perch and frogs.

Fence to exclude cattle from the waterbody and surrounding seasonal wetland at Towts Swamp.

This would conserve wetland conservation values and minimise habitat degradation and disturbance. The swamp is a registered Land for Wildlife wetland. Provision of assistance in the form of technical advice and materials to enable stock exclusion and revegetation would be desirable. The upper section of the swamp on the neighbouring property was deepened and extended in 1991. It supports small numbers of waterbirds but is heavily grazed. It should also be fenced.

More extensive herbfields at Towts Swamp, while attracting greater numbers of the species already present, would provide feeding and breeding habitat for the threatened cover-dependent species recorded between 1986 and 1990. These include the Baillon's Crane, Spotless Crane, Little Bittern and Australasian Bittern. Other rare species including the Buff-banded Rail and Brown Quail which are present at Mornmoot Lake may also be attracted.

Habitat enhancement works. The exclusion of cattle would enable the stalks of Tall Spike-sedge to form rafts for nesting waterbirds (including potentially the Swamp Harrier). Logs placed in the shallows would provide roost sites for birds and habitat for invertebrates and frogs. This would attract more waders. As planted Swamp Gums and Swamp Paperbarks mature and branches fall, additional habitat for frogs will be created. The placement of branch heaps may enable the re-establishment of Glossy Grass Skinks and Southern Water Skinks. Floating rafts would provide additional and more secure (from foxes) breeding habitat for waterfowl including the Blue-billed Duck and Australasian Shoveler. Maintenance of nesting waterbird populations will require human disturbance to be kept to minimum levels.

Removing biomass from wetlands through grazing directly lowers the diversity of invertebrate detritivores and herbivores and indirectly the carnivores and their vertebrate predators higher in the food chain (Cameron 1992). Nutrient pooling in the form of livestock faeces can contribute to algal blooms. As the algae decay they deplete the water of oxygen (eutrophication) and lower the water quality. In such systems invertebrate diversity is depressed (Cameron 1992).

Effect of motor traffic along Wallan Road on waterbirds at Towts Swamp. With the cover loss and increased level of traffic, the threshold level of tolerance of waterbirds to disturbance from Wallan Road has been exceeded. There are substantially fewer resident waterbirds (even species such as the Chestnut Teal which were common breeding residents). The cover-dependent species are now very rare. Waterbirds visiting the swamp are predominantly transient visitors.

Protection of international migratory wader habitat. The habitat of sandpipers and Latham's Snipe is formally protected under international agreement between Australia and China (CHAMBA) and Japan (JAMBA). It is most important that management of the swamp is in compliance with the protection of these globally diminishing habitats.

Wetland education and bird observatory potential. With the provision of screen plantings of Swamp Paperbark and Swamp Gum around the swamp margin a bird hide could be set up on the high ground overlooking the swamp. With intact emergent herbfields, it would provide an excellent viewing point for waterbirds. From the roadway the whole swamp can be viewed, but without adequate cover cars disturb the waterbirds. A swampy woodland screen from the road would be desirable.

PUAP B PLENTY RIVER YAN YEAN

This management unit consists of two sites of state faunal significance (sites 38 and 39) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 332378 to 7922 342450 (Plenty River).

Location/Size: Swamps and floodplains and an anabranch of the Plenty River from Masons Lane Mernda to 500 m north of Cades Road Yan Yean and the lower reaches of Barbers Creek. Two farm lakes between the Plenty River and Plenty Road are included. Approximately 610 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit lies on the alluvial plains of the Eastern Uplands. It forms a floodplain area in the middle reaches of the Plenty River. This occurs in a depression between the upfolded Whittlesea anticline to the west (hills running parallel to Plenty Road) and the uplifted basin forming the Kinglake Plateau of the Great Dividing Range to the east and north. The sedimentary hills west of Plenty Road separate the unit from the volcanic plains. Swamps have developed downstream of the confluence of the Plenty River and Bruces and Shrubby creeks and upstream of the Plenty Gorge. The low ground is constricted on both sides by bluffs and low hills and to the north by the ranges.

Landforms

Alluvial plain: plain-slopes, creeks, river valley/alluvial floodplain, stream confluence, shallow freshwater marsh, farm lakes and dams. Volcanic plain: stony plains (south of Barbers Creek). Elevation is 170–210 m.

Hydrology

The draining of the Whittlesea swamps stopped the gradual seepage that replenished the Plenty River (Kenna 1988). This was particularly important in dry summer–autumn periods when surface runoff was minimal. The swamps regulated the flow of the river by retaining winter–spring runoff and slowly discharging it over summer (Kenna 1988). This maintained an adequate flow over summer and a system in which flash flooding was less frequent. The diversion of water from the Plenty River with the building of Yan Yean Reservoir and Toorourrong Reservoir has severely reduced the summer river flow. During floods an extensive area of water backs up. This is constricted by the head of the Plenty Gorge and by bluffs to each side. The bluestone Toorourrong–Yan Yean Aqueduct crosses the higher ground in the north-eastern corner of the unit.

Dunnetts Road Swamp is a semi-permanent shallow freshwater marsh of 1–2 ha. A levee bank created by Dunnetts Road has slightly raised the depth of water and prolonged inundation periods. It was originally part of an 1850 ha freshwater marsh system known as Ryder Swamp. Little remains in partly natural condition, Dunnetts Road Swamp being the most intact. Staglianos Lake is the largest waterbody on the alluvial plains and the largest permanent shallow freshwater marsh in NEM. It normally covers 4–5 ha but inundates another 1 ha of shallows for several months of the year. When full at least 80% of the lake contains water less than 1 m deep. This supports extensive submerged herbfield. It is dammed by a rock wall at the south end.

Both Dunnetts Road Swamp and Staglianos Lake were originally part of an extensive River Red Gum riverine forest and shallow freshwater marsh and paperbark scrub system between the bluffs west of Plenty Road and the Plenty River. The riverine forest was cleared and ringbarked soon after settlement. Tree density exceeded 100 trees/ha and was composed of tall non-spreading trees with boles of up to 15 m before branching (see p.76 in Wuchatsch & Hawke 1988). It structurally resembled riverine forests of the Murray/Goulburn River. The present stands of swamp scrub at Yan Yean have regenerated as the early photo of 1875 shows them to be absent.

Rainfall: 660–680 mm.

Site 38 Dunnetts Road Swamp–Plenty River Cades Road

Map Reference:	7922 337428 to 7922 3433450 (Plenty River); 7922 345441 (Dunnetts Road Swamp). One minute lat/long grids include 37° 31' x 145° 07' and 37° 32' x 145° 07'.
Location/Size:	Approximately 170 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: Melbourne Water (Target Paddock/Dunnetts Road Swamp at the north-west corner of Yan Yean Reservoir). Private: areas west of Dunnetts Road lying within the Plenty Growth Corridor. These are zoned stream and floodway (MPE 1990).
Landforms:	Alluvial plain (see PUAP B). Elevation is 190–210 m.

Natural Heritage Values

Landscape. Dunnetts Road Swamp is the most intact River Red Gum marsh remaining in NEM. It is all that remains of what was the largest area of River Red Gum marshland in NEM. The Rush Sedge–Common Spike-sedge seasonal wetland at Dunnetts Road Swamp is one of only three known to remain on the alluvial plains of NEM covering more than one hectare that are relatively intact. The others are Banyule Swamp (site 33) and Wilton Vale Marsh (site 40). This habitat is disjunct in GM. The wetland has high landscape values and needs to be protected and managed for conservation.

Dunnetts Road Swamp has biogeographical affinity with the riverine plains of northern Victoria (e.g. riverine forest/avifauna). It also has an overlap of elements from Gippsland (e.g. swamp scrub). Along with Brennans forest in the Mernda to Yan Yean site, Dunnetts Road Swamp is the best illustration of the transition occurring in NEM between the biota of the Goulburn River Plains and Gippsland Coastal Plains.

Scientific and Educational Values

Invertebrates. Freshwater crayfish (*Engaeus quadrimanus*) at Dunnetts Road Swamp

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Rush Sedge–Common Spike-sedge seasonal wetland (25.1; Dunnetts Road Swamp)

Relatively intact and extensive stands: Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7); Blunt Pondweed (submerged herbfield) permanent wetland (26.1)

Partially intact or small stands: River Red Gum (alluvial plain) grassy woodland (14.3); Manna Gum (riverbank) floodplain riparian woodland (16.4); Common Tussock-grass–Tall Sedge seasonal wetland (25.5)

Remnant, degraded or establishing stands: River Red Gum riverine forest (7.1); Yellow Box–Candlebark valley forest (31.1); Swamp Paperbark swamp scrub (17.1); Swamp Gum swampy woodland (27.1)

Rare species: River Swamp Wallaby-grass

Critical assemblages or populations: River Red Gum Marshland Critical Conservation Area (Dunnetts Road Swamp). Along with stands at the north end of Yan Yean Reservoir, the most intact stand of Rush Sedge–Common Spike-sedge seasonal wetland in NEM. Floodplain wetlands are unique ecosystems which provide breeding habitat for waterfowl, cover-dependent waders and fish and cover and feeding habitat for migratory birds such as snipe. These wetlands are undervalued in their roles in flood control, groundwater recharge, erosion control and water purification.

FAUNAL SIGNIFICANCE: Site 38 Dunnetts Road Swamp–Plenty River Cades Road

Assessment: State—Category 2 (B, C, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

38^a: 37° 31' x 145° 07'; Plenty River at Cades Road

38^b: 37° 32' x 145° 07'; Dunnetts Road Swamp/Plenty River

A. Cited Zoological Significance

Regional. Plenty–Darebin River Red Gum woodlands: Beardsell (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 38^b: Baillon's Crake, Little Bittern, Australasian Bittern, Eastern Broad-nosed Bat, Glossy Grass Skink

Regional. 38^a: Glossy Grass Skink, Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

g. Breeding parrots

Regional. 38^b: 5 species at Dunnetts Road Swamp on 6 November 1992

h. Bats

State. 38^b: 8 species including the Eastern Broad-nosed Bat and Eastern Freetail Bat trapped at Dunnetts Road Swamp between 6 and 14 February 1989

k. Frogs

Regional. 38^b: 8 species including the Victorian Smooth Froglet, Bibron's Toadlet, Common Spadefoot Toad and Plain's Froglet at Dunnetts Road Swamp on 24 April 1992

m. Freshwater fish

Regional. 38^b: 4 species from the Plenty River at Cades Road on 14 December 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 38^b: over 120 species

b. Native birds

Regional. 38^b: over 90 species

c. Native mammals

Regional. 38^b: 13 species (9 species of bats)

d. Herpetofauna

Regional. 38^b: 18 species (12 species of frogs)

e. Freshwater fish

Regional. 38^a: 4 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 38^b: 23 species. **Local. 38^a**: 6 species

b. Regionally endangered fauna (R1 species)

State. 38^b: 4 species. **Birds**: Wood Sandpiper, Glossy Ibis, Red-backed Kingfisher. **Mammals**: Eastern Broad-nosed Bat

c. Regionally vulnerable fauna (R2 species)

State. 38^b: 9 species. **Birds:** Baillon's Crake, Spotless Crake, Black-tailed Native-hen, Little Bittern, Australasian Bittern, Brown Treecreeper. **Mammals:** Eastern Freetail Bat. **Reptiles:** Glossy Grass Skink. **Frogs:** Peron's Tree Frog

Regional. 38^a: 1 species. **Reptiles:** Glossy Grass Skink

d. Regionally rare fauna (R3 species)

Regional. 38^b: 4 species. **Birds:** Australian Spotted Crake, Collared Sparrowhawk, Little Corella. **Frogs:** Plains Froglet

Regional. 38^a: 3 species. **Birds:** Little Corella. **Frogs:** Plains Froglet. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 38^b: 6 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, White-winged Triller, Rufous Songlark. **Frogs:** Bibron's Toadlet

Regional. 38^a: 2 species. **Fish:** Mountain Galaxias, Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 38^b: 11 species. **Birds:** Nankeen Night Heron, Great Egret, Cattle Egret, Little Eagle, Barn Owl, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella. **Reptiles:** Delicate Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

g. Nesting birds of prey/parrots

Regional. 38^b: Collared Sparrowhawk (stick nest in a River Red Gum at Dunnetts Road Swamp on 6 November 1992)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 38^b: 10 Latham's Snipe at Dunnetts Road Swamp on 22 December 1989

b. Rare or threatened fauna

State. 38^a: highest known population density of Glossy Grass Skinks in GM (13 in a 2-hour search along the Plenty River floodplain at Cades Road on 17 October 1988)

e. Lorikeets

Regional. 38^b: over 50 in flowering River Red Gums at Dunnetts Road Swamp on 22 December 1989: Musk Lorikeet (40), Little Lorikeet (12) and Purple-crowned Lorikeet (2)

f. Frogs

State. 38^b: over 50 each of the Peron's Tree Frog, Verreaux's Tree Frog, Common Bullfrog and Growling Grass Frog at Dunnetts Road Swamp on 6 November 1992

g. Rare/restricted colonial fauna

Regional. 38^b: 50 Cattle Egrets and 70 Australian White Ibis roosting in the River Red Gums at Dunnetts Road Swamp on 19 August 1990

j. Electrofishing or netting rate

Regional. 38^a: Plenty River Anabranh at Cades Road: 113 fish: Short-finned Eel (12), Common Galaxias (1) and Southern Pigmy Perch (100). Plenty River at Cades Road: 57 fish: Short-finned Eel (5), Mountain Galaxias (1), Common Galaxias (1) and Southern Pigmy Perch (50)

l. Regionally vulnerable fauna (R2 species)

Regional. 38^b: over 50 Peron's Tree Frogs at Dunnetts Road Swamp on 9 December 1988 and 6 November 1992

n. Regionally depleted fauna (R4 species)

Regional. 38^a: Southern Pigmy Perch at Cades Road on 14 December 1988: 100 in anabranch and 50 in river

Outlook

Horse grazing has lowered the significance for cover-dependent waterbirds and frogs at Dunnetts Road Swamp. If this activity were to stop and a conservation management program were to be undertaken, faunal values would be returned.

FAUNA

Rare or Threatened Fauna

Bc 38^b: Baillon's Crake, Little Bittern and Australasian Bittern at Dunnetts Road Swamp. The swamp supports Rush Sedge–Common Spike-sedge seasonal wetland (25.1) in the shallower eastern section and Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) and Blunt Pondweed–Pacific Azolla (submerged herbfield) permanent wetland (26.1) in the deeper section near Dunnetts Road. It is fringed by River Red Gum (alluvial plain) grassy woodland (14.3).

The Baillon's Crake was recorded on 22 February 1990 while the Little Bittern was seen on 17 October 1988 and 14 November 1989. These two species likely breed at the swamp. Both inhabit permanent freshwater wetlands containing submerged/floating and emergent herbfields. Reporting suggests they are annual spring–summer migrants from further north in Australia (Blakers *et al.* 1984, Emison *et al.* 1987). Small numbers (mostly juveniles) over-winter at coastal freshwater marshes (e.g. Baillon's Crake in June 1991 at Laverton Saltworks). The combination of the reclusive nature and dense, marshland habitat of the Baillon's Crake and Little Bittern may have led to them being overlooked in winter.

The Baillon's Crake is the rarest and smallest of the crakes in NEM. It was active during the day at Dunnetts Road Swamp, darting amongst the edge of Rush Sedge–Common Tussock-grass (25.1) and in mud at the water's edge. It also skipped amongst Water-ribbons (25.7) with the aid of its long toes and occasionally dived into the water (26.1). The crake pecks small crustaceans, molluscs and insects and aquatic herbage and seeds (Readers Digest 1986).

The Little Bittern is predominantly nocturnal and hunts by standing motionless to pounce for fish, insects, crustaceans and frogs in the shallows, on mudflats or from fringing or emergent vegetation (Blakers *et al.* 1984). On both occasions at Dunnetts Road Swamp it was amongst Tall Spike-sedge (25.7).

The Australasian Bittern was observed in Rush Sedge–Common Spike-sedge seasonal wetland (25.1) on 24 October 1994 (see also site 2). They are secretive, cover-dependent and generally intolerant to human disturbance. The Australasian Bittern hunts at night in a similar manner to the Little Bittern, by stalking in the shallow water (26.7 and 26.1). Crustaceans including the freshwater crayfish (*Engaeus quadrimanus*), which is present at Dunnetts Road Swamp, are an important food source. These invertebrates are dependent on low water turbidity conditions and adequate aquatic vegetation. Frogs, which are abundant in the swamp, are also important prey. In recent years livestock grazing and trampling at the swamp has decreased cover for the bitterns and crake and the habitat of their prey.

Bc 38^b: Eastern Broad-nosed Bat at Dunnetts Road Swamp. Three were taken by harp trap and a fourth was triplined on a dam amongst River Red Gum grassy woodland (14.3) between 6 and 14 February 1989. In GM there is a strong correlation between the distribution of the Eastern Broad-nosed Bat and Swamp Paperbark. The main distribution of both in Victoria is the coastal drainages of Gippsland.

Bc 38^a: Mountain Galaxias. One electrofished from the Plenty River at Cades Road on 14 December 1988. This is its most downstream occurrence in the Plenty River system.

Critical Assemblages or Populations

Ch **38^b: High diversity of bats at Dunnetts Road Swamp.** Eight species including four Eastern Broad-nosed Bats and one male Eastern Freetail Bat were trapped between 6 and 14 February 1989 under River Red Gum grassy woodland (14.3). A ninth species that was not trapped (White-striped Freetail Bat) was frequently heard calling overhead while triplining on 14 February. This is the second highest bat diversity to Fenwick Stud (site 15) amongst pure stands of River Red Gum in NEM. The trapping effort involved 16 trapnights by harp trap and a night triplining on a dam. The harp traps were placed over drying pools under overhanging River Red Gum branches. The tripline was placed over a small dam to the north of the swamp where there are many old trees that support hollows.

Bc/Fb **38^a: Highest known population density of Glossy Grass Skinks in GM at Cades Road.** The main population of the Glossy Grass Skink in NEM occurs between Barbers Creek and Whittlesea on the Plenty River floodplain, particularly the timbered margins of watercourses and swamps. The species is rare throughout its Australian range (Hutchinson & Donnellan 1988). Thirteen were recorded in a 2-hour search of Manna Gum floodplain riparian woodland (16.4) and remnant Swamp Paperbark swamp scrub (17.1) and Swamp Gum swampy woodland (27.1) along the floodplain of the Plenty River to each side of Cades Road on 17 October 1988.

The Glossy Grass Skink is an obligate wetland species associated with dense tall shrub cover and humid micro-environments (Hutchinson & Donnellan 1988). They inhabit damp, ground-level cover of herbs and dense leaf litter, fallen branches and logs at swamps and along stream floodplains. They exploit shaded environments provided sun-basking sites are available. At Yan Yean they associate with areas of River Red Gum, Swamp Gum or Swamp Paperbark and are rare or absent from wetlands lacking eucalypts or paperbarks. They have been recorded under stumps and logs including old fenceposts or railway sleepers (e.g. along the abandoned Whittlesea railway).

Glossy Grass Skinks are a diurnal, fast-moving skink and remain active on cool sunny days in spring. The litter size ranges from four to eight (Hutchinson & Donnellan 1988). Females ovulate and mate in mid-spring and young are born in early summer. The prey are bark, mudflat and detritus invertebrates such as ants, insect larvae, freshwater shrimps, slaters, molluscs (particularly earthworms and flatworms), slugs and snails. From a scanning perch on a log they pounce on flying insects such as moths and flies.

At the time of European settlement, Swamp Paperbarks extended further upstream and downstream than at present. It is estimated that less than 5% of the original paperbark stand persists along the floodplain. The Glossy Grass Skink is predominantly found in south-eastern Victoria in a series of disjunct and depleted populations. The paperbark swamps of the Plenty River and their remnant ground fauna are now depleted and isolated from the nearest occurrences to the east and south-east of Melbourne. The Glossy Grass Skink has not been recorded in GM west of the Plenty River. The range overlaps with the closely related Tussock Skink (of volcanic plains grasslands) near Mernda and comes into close contact with the Southern Grass Skink (of mountain forest) at Toorourrong Reservoir.

Other Significant Fauna

Birds

Eb **38^b: Wood Sandpiper at Dunnetts Road Swamp.** The only sighting in NEM was on drying mudflats amongst Rush Sedge–Common Spike-sedge seasonal wetland (25.1) on 29 January 1988, three weeks after heavy rains. The swamp is lined with River Red Gums and the eastern section is fringed by the seasonal wetland. The more permanent western section near Dunnetts Road supports Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7) and Blunt Pondweed–Pacific Azolla (submerged herbfield) permanent wetland (26.1). Wood Sandpipers are rare spring–summer migrants to southern Australia from the northern hemisphere. Conservation of this species in Australia depends on protecting shallow non-coastal freshwater swamps (Lane & Davies 1987).

Eb **38^b: Glossy Ibis—inland drought visitor to Dunnetts Road Swamp.** Three were present in Rush Sedge–Common Spike-sedge seasonal wetland (25.1) fringing the east side of the swamp on 24 October 1994. A week later, a Glossy Ibis was recorded at Wilton Vale Marsh in Plenty Gorge Park (site 40). This species had been seen on two earlier occasions at Dunnetts Road Swamp. These were in spring 1978 and spring 1979, following the 1977 drought. A flock of 15 birds was present for about two weeks from late October to early November 1979 before moving on. There

was an influx into River Red Gum shallow freshwater marshes to the west of Melbourne in 1985 and 1986. The marshes contained mudflats, open water and ample cover of emergent sedges and fringing grassland.

Dunnetts Road Swamp and Wilton Vale Marsh are the only wetlands in NEM that provide this combination of habitats. At Dunnetts Road Swamp, Glossy Ibis were observed feeding on frogs and aquatic invertebrates, such as crustaceans, taken in the shallow water and grasshoppers and worms from the grassy surrounds of the wetland. On one occasion they were seen in flooded pasture on the west side of the road. While Dunnetts Road Swamp provides suitable cover, it is frequently disturbed by humans and visits by species such as the Glossy Ibis are largely transient.

Eb **38^b: Red-backed Kingfisher at Dunnetts Road Swamp.** A pair was nesting in a River Red Gum (grassy woodland; 14.3) on 6 November 1992. This was only the second sighting for the GM study (the other was to the south-west of Melbourne at Richmonds Swamp north of Little River in March 1990). The species is an uncommon summer migrant from northern Australia to riverine areas of northern Victoria. Vagrants occasionally appear in southern Victoria.

Ec **38^b: Spotless Crake and Black-tailed Native-hen at Dunnetts Road Swamp.** The crake was seen on 17 October 1988. An Australian Spotted Crake (*Ec*) was subsequently seen on 26 October 1989. Both were observed in Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7). Two Black-tailed Native-hens were present in Rush Sedge–Common Spike-sedge seasonal wetland (25.1) at the rear of the swamp on 9 December 1988. The mudflats, bare edges and fringing tussock herbfield under River Red Gums is typical habitat for native-hens in GM. Fringing scrub would be beneficial. Human disturbance and loss of retreat cover due to livestock grazing is a problem as the species is rather shy.

Ec **38^b: Brown Treecreeper at Dunnetts Road Swamp.** One present at the rear of the swamp in River Red Gum grassy woodland (14.3) on 26 October 1989. This species has become locally extinct over the last decade in several biophysical zones of NEM. The most substantial population remaining is to the east of Dunnetts Road Swamp in Yan Yean Reservoir (site 91).

Ee **38^b: Brown Quail, Buff-banded Rail and Latham's Snipe at Dunnetts Road Swamp.** The Rush Sedge–Common Spike-sedge seasonal wetland (25.1) fringing the eastern section of the swamp is particularly important for Latham's Snipe. Birds are present most years in spring and early summer. Ten were recorded on 22 December 1989. The Buff-banded Rail was recorded on two occasions (26 October 1989 and 18 December 1989) while the Brown Quail was seen on 14 November 1989. Both species were in Rush Sedge–Common Spike-sedge seasonal wetland (25.1) where they likely bred.

38^b: River Red Gums—parrots and other hollow and stick nesting birds. Five species of parrots were nesting in the River Red Gum hollows at Dunnetts Road Swamp on 6 November 1992. These included about 10 pair of Sulphur-crested Cockatoos and the Galah, Red-rumped Parrot, Crimson Rosella and Eastern Rosella. The swamp contains a high diversity of parrots (11 species). Over 50 lorikeets, including the Musk, Little and Purple-crowned, were present in the flowering River Red Gums on 22 December 1989.

The Australian Wood Duck and Sacred Kingfisher breed in the tree hollows. The White-faced and White-necked Herons breed in stick nests in the River Red Gums during spring. White-necked Herons are largely winter visitors to NEM and have been infrequently recorded breeding. The River Red Gums and presence of waterbirds attract bird of prey species. A Collared Sparrowhawk was nesting on 6 November 1992. A single Little Eagle and Brown Goshawk were observed on several occasions.

Mammals

Ec **38^b: Eastern Freetail Bat at Dunnetts Road Swamp.** A male was trapped on 9 February 1989 under River Red Gum grassy woodland (14.3). The Eastern Freetail Bat occurs in the lowlands of the eastern half of Victoria. It is representative of River Red Gum riverine forests of the Murray/Goulburn River and coastal forests of East Gippsland. The freetail bat is uncommon to rare throughout its range and is usually trapped near water.

Frogs

Ec **38^b: Peron's Tree Frogs at Dunnetts Road Swamp and the most diverse frog fauna in NEM.** The range of the Peron's Tree Frog (like the Eastern Freetail Bat) illustrates the relationship between the site and the riverine forests of the Murray/Goulburn River and the Gippsland Coastal Plains as it occurs in both. Its presence in NEM is disjunct from these areas. Several thousand years ago in a warm, wet climate this range was probably continuous. Dunnetts Road Swamp is the best frog listening area in NEM. The machine-gun chorusing of Peron's Tree Frogs on balmy late spring evenings is spectacular. The frog was observed foraging amongst bark on River Red Gums (particularly decaying logs lying at the edge of the water) for beetles, spiders and slaters. The site contains the most diverse assemblage of frogs in NEM (12 species). There is an interesting co-occurrence of ranges and plains species (e.g. Victorian Smooth Froglet and Common Spadefoot Toad). The froglet is rare on the plains. It occurs in the paperbark scrub along the Plenty River.

Freshwater fish

Ee **38^a: Southern Pigmy Perch.** They inhabit waters with instream herbfields. The section of the Plenty River passing through the alluvial floodplain swamps between Yan Yean and Glenvale forms their optimal habitat in the system (Closs 1984). Substantial populations of Southern Pigmy Perch and Short-finned Eels were recorded in the Cades Road section during an electrofishing survey of the Plenty River on 14 December 1988 (McKenzie 1989). The Common Galaxias (*Ed*), which is a migratory species was also sampled.

The Cades Road/Dunnetts Road and Mernda to Yan Yean sites are important for native fish. On the basis of the dominance and diversity of instream and riparian habitat the middle reach floodplain swamps of the Plenty River and Yarra River may have been one of the most important areas in NEM for native fish. They possibly supported the Dwarf Galaxias, Spotted Galaxias, Tasmanian Mudfish and Yarra Pigmy Perch. The diversity still present in the Plenty River is largely due to the absence of Roach, which is an aggressive competitor and voracious predator of small native species. The Plenty River contains an anabranch and broad floodplain at Cades Road, supporting a diverse marshland system. The shaded pools amongst the roots of the paperbarks and willows contain slack water and abundant submerged herbfield and aquatic invertebrate life. These support the most important area for the Southern Pigmy Perch in NEM.

38^a: Electrofishing Survey: Plenty River–Cades Road

Map reference. 7922 342443. **Altitude.** 190 m. **Survey date.** 14 December 1988

Vegetation. Instream: submerged and emergent herbfield (20% cover of algae). Bank: Manna Gum floodplain riparian woodland (16.4; poor condition). Frontage: Swamp Paperbark swamp scrub (17.1); Common Tussock-grass–Tall Sedge seasonal wetland (25.5); Swamp Gum swampy woodland (27.1). Each has been heavily cleared.

Physical Features:**Pools**

Substrate. Deep silt and logs on alluvial clay base

Maximum size (mid-summer). 8.0 m wide by 1.8 m deep by 40 m long

Riffles

Substrate. Silt, sand and gravel on alluvial clay base

Flow (mid-summer normal): Size. 1.0 m wide by 15 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 6.8 ML/day

Water quality

Summer: Temperature. 21°C. **Conductivity.** 300 ms. **Turbidity.** Moderate

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (5); migratory sub-adult. Mountain Galaxias (1); likely breeding resident. Common Galaxias (1); passage migrant (also present in the adjacent Toorourrong–Yan Yean aqueduct). Southern Pigmy Perch (50); likely breeding resident

Alien species numbers/status. Goldfish (2); likely breeding resident. Redfin (2); likely breeding resident. Mosquito Fish (100); likely breeding resident.

38^a: Electrofishing Survey: Plenty River–Anabranh at Cades Road

Map reference. 7922 341443. **Altitude.** 190 m. **Survey date.** 14 December 1988

Vegetation. Instream: submerged and emergent herbfield (40% cover of algae). Bank/frontage: as previous, but more degraded.

Physical Features:

Pools

Substrate. Deep silt on alluvial clay base

Maximum size (mid-summer). 5.0 m wide by 1.0 m deep by 40 m long

Riffles

Substrate. Silt, sand and gravel on alluvial clay base

Flow (mid-summer normal): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Water quality

Summer: Temperature. 22.5°C. **Conductivity.** 330 ms. **Turbidity.** Moderate

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (12); migratory sub-adult. Common Galaxias (1); passage migrant. Southern Pigmy Perch (100); likely breeding resident

Alien species numbers/status. Goldfish (20); likely breeding resident. Mosquito Fish (100); likely breeding resident.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Intact habitat link to the Yan Yean Reservoir and Plantations site. Fragmented link to the Mernda to Yan Yean site.</p>	
<p>Severance of habitat links.</p> <p>Eucalyptus dieback. Leaf defoliation, dieback and death of mature River Red Gums, Yellow Box and Swamp Gums is widespread.</p>	<p>Strengthen habitat links. The site is important as it supports threatened habitats and fauna species. Conservation of existing habitat and the enhancement of links is required.</p>

Regional Hydrological Strategy

Pollution and nutrient enrichment from farm and urban development, inadequate stream flow from water diversion and loss of native riparian vegetation by clearing and stock grazing have combined to cause profound changes to the river ecosystem.

Clearing, draining and degradation of wetland habitat—historical era. The Yan Yean marshland formerly extended upstream of Whittlesea to the Glenvale marshland. Soon after settlement most was drained and reclaimed and the trees and shrubs were cleared. Only remnant stands survived. The watercourses originally fanned over the marshland through numerous channels, lagoons, marshes and meadows. These functioned as filtering and depositional areas for alluvium carried from upstream. Their loss in combination with heavy land clearing and livestock grazing in the catchments caused silt from eroding surfaces to be dumped into the stream. Removal of riparian vegetation by clearing and grazing caused bank slumping and river channelisation.

Clearing, draining and degradation of wetland habitat—modern era. Species such as the Glossy Grass Skink are threatened by current management on private land containing the paperbark swamps at Yan Yean. Native vegetation cover loss and degradation associated with livestock grazing and bank erosion continues. Water pollution has increased. Weed infestation has resulted, particularly of White Crack Willow, Blackberry, Toowoomba Canary-grass, Bulbil *Watsonia*, Cleavers, Drain Flat-sedge, Blue Periwinkle, Three-cornered Garlic, Japanese Honeysuckle and Wandering Jew.

Declining water quality and biological values of the river. The river ecosystem will not withstand further increase in human population in the catchment without substantial loss of native flora and fauna species. The Cades Road sewage treatment plant has eased the septic tank output from Whittlesea township but the summer water quality has noticeably deteriorated. The decreased amount of untreated discharge from Whittlesea is outweighed by the impact of new unsewered subdivisions in the catchment. New dams on these properties further contribute to loss of stream flow and loss of native instream habitat and fauna.

With urban development polluted stormwater runoff is produced and the fragile and stressed stream ecosystem regresses. The deleterious effects of long-term stream degradation associated with rural land-use becomes more pronounced. There is little monitoring or control of the environmental damage caused to the river.

Implementation of Native Vegetation Clearance Controls on private land. Areas containing significant natural habitat on private land need to be protected.

Wetland conservation management plan required. A plan including revegetation of the Plenty River and Dunnetts Road Swamp should be devised and implemented.

Improve water quality of the Plenty River. The establishment of a streamway land-use and conservation strategy to improve the water quality of the river needs to be addressed.

Depleted flow regimes of the river. Water storages and stream diversions in the Hume Ranges and dams in rural catchments have greatly reduced the summer–autumn flow of the Plenty River. There has also been a substantial reduction in summer flow with the draining of the Whittlesea swamps. The swamps were estimated to hold back 50% of the winter–spring stream flow, releasing it by gradual seepage through the summer months (MMBW 1976).

This has led to altered flow patterns. Winter–spring flooding peaks have shortened. Inadequate flow at these times has eliminated vertebrate species adapted to fast-running water (e.g. Australian Grayling) and those dependent on seasonally flooded habitat for breeding (e.g. Peron’s Tree Frog and Spotted Galaxias). Draining shallow marshland has also affected these species. Bird populations have declined directly through loss of cover and breeding habitat and indirectly through loss of food. Summer–autumn flow rates have declined below critical levels, eliminating several species (e.g. Platypus and Freshwater Blackfish). Anabranch pools have become stagnant, depleted in dissolved oxygen and brackish.

Dunnetts Road Swamp—lacks adequate regeneration. Known locally as the Target Paddock, the swamp is owned by Melbourne Water. It is agisted for stock grazing. Regeneration of River Red Gums and native understorey shrubs has been prevented and trampling has caused severe pugging of the muddy substrate. Grazing of the seasonal wetland by livestock has reduced the cover for species such as the Little Bittern, Latham’s Snipe and Spotless Crake. Fallen limbs, trunks and stumps have been removed from the swamp, which has depleted the reptile fauna.

Restoration of more natural stream flow and hydrological cycle. The disruption of the hydrological cycle of the Plenty River and impact from development continues. The establishment of a hydrological cycle strategy for the river is an urgent conservation issue in need of address within the City of Whittlesea.

Conservation management of Dunnetts Road Swamp. River Red Gum marshland in the Plenty Valley has been depleted by rural land-use and remaining areas are under pressure from residential development. The swamp has significant fauna and flora values, but current management (particularly livestock grazing) is lowering the wetland fauna and habitat values. It is essential that the swamp is protected and formally recognised as a wildlife/wetland sanctuary. Some revegetation work is required but the pressing issue is that the livestock grazing needs to cease. The habitat and faunal changes associated with removing livestock should be closely monitored. With stock removal grassy weeds will proliferate and may create a fire hazard. Perimeter slashing may need to be implemented until grazing pressure from Eastern Grey Kangaroos takes effect.

Debris should remain on the ground as it provides habitat for herpetofauna species including the Glossy Grass Skink and Peron’s Tree Frog, as well as cover and invertebrate food for waterbirds. In its original form with Swamp Paperbark in the understorey, Dunnetts Road Swamp would have likely contained suitable habitat for the rare Swamp Skink (presumed extinct in NEM). Burrows of this skink are susceptible to trampling from livestock. A trapping study should be conducted to determine its presence or the suitability of the area for reintroduction. Replanting of shrubs including Swamp Paperbark is required.

There is considerable disturbance to bird life in the swamp from humans and passing vehicle traffic. As Dunnetts Road already becomes cut-off during floods, closure for longer periods during spring–early summer might be considered. This would provide added security for waterbirds during their breeding season. Closing access to the swamp with a more secure fence along Dunnetts Road would be desirable. This might also restrict timber removal.

Electrofishing sites. Livestock access to the Plenty River/Anabranche has prevented regeneration of native riparian vegetation. Runoff after rainstorms is sudden and rapid, causing severe channel scouring and bank erosion. The Freshwater Blackfish and Platypus, which were reported by residents some 30 years ago, were not recorded. Increased levels of stream degradation in the site and soil disturbance and water contamination in the catchment will likely eliminate native fish species and promote their replacement by alien species.

Revegetation and stock exclusion from the Plenty River streamway. Sections should be fenced to restore the seasonal floodplain wetlands with marshland vegetation. Trees and shrubs need to be planted along sections of the river and the pasture-dominated meadows need to be replanted with native sedge and grass species. Stream and freshwater wetland vegetation provides the bulk of the terrestrial food and breeding habitat of native fish (e.g. galaxias) and feeding and nesting habitat for small wading birds (e.g. crakes and rails) and frogs.

Nutrient turnover is derived from microbial and invertebrate decomposition of organic material fallen from stream bank vegetation (Koehn & O'Connor 1990). The detritus invertebrates are the primary food source of many native fish (e.g. Southern Pigmy Perch). Logs, roots and fallen debris of stream bank vegetation are critical for the survival of some species (e.g. Glossy Grass Skink). As well as providing homes for instream fauna the roots stabilise the banks, preventing erosion. The stream banks are in need of weed control.

Strict adherence to water quality controls in the Plenty River.

Conservation Measures for Other Issues

Stream and Floodway Zone. The site lies within the Plenty River Stream and Floodway Zone proposed for the Plenty Growth Corridor (MPE 1990). The conservation objectives of the zone require resource allocation for management to be undertaken. Effective environmental research and monitoring is required to improve the level of protection of streamway habitats.

Formation of a community land protection group. Landowners need to be encouraged to protect native habitat. With their cooperation, all areas of native vegetation on private land within the site need to be brought under conservation management. With management that reduces the level of disturbance and other habitat degrading processes, additional faunal species would be recruited and existing species diversity would be enhanced. This can be best achieved through the formation of a community land protection group.

River Red Gum Marshland Critical Conservation Area. Dunnetts Road Swamp.

Site 39 Mernda to Yan Yean

- Map Reference:** 7922 332378 to 7922 337428 (Plenty River); 7922 7922 331408 (Srebenowskis Lake); 7922 332419 (Staglianos Lake); 7922 337390 (mid-point of census plots at Brennans forest); 7922 326394 (mid-point of census plots on the old Whittlesea railway); 7922 330418 (mid-point of census plots on Old Plenty Road). One minute lat/long grids include 37° 33' x 145° 06' and 37° 34' x 145° 06'.
- Location/Size:** Approximately 440 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: sections of old Whittlesea railway (V Line) and the Yan Yean flume track (Melbourne Water). Private: zoned within the Plenty Corridor as Stream and Floodway.
- Landforms:** Alluvial plain and volcanic plain (see PUAP B). Elevation is 170–180 m.

Natural Heritage Values

Landscape. Some of the most intact sections of the Plenty River floodplain in the Plenty Upland Alluvial Plains. The woodland section south of the Yan Yean–Arthurs Creek Road has been partly protected as it is contained on larger farm properties (e.g. 'Brookwood'). The site forms the meeting point of the alluvial and volcanic plains and upland hills. It includes the only natural stand of riverine forest remaining in GM and the most extensive stands of swamp scrub remaining in the Plenty River system.

Scientific and Educational Values

Scientific reference. River Red Gum bird census plots in Brennans forest on the east side of the Plenty River between the confluence of the Barbers Creek and Arthurs Creek Road (plots 1, 2, 3 and 4), along the old Whittlesea railway to the south of the Barbers Creek (plots 5 and 6) and on the Old Plenty Road between Arthurs Creek Road and Reservoir Road (plots 20 and 21).

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: nil

Relatively intact and extensive stands: River Red Gum (volcanic plain) grassy woodland (14.1); Blunt Pondweed–Many-fruit Tassel (submerged herbfield) permanent wetland (26.1); River Red Gum (plains) drainage line woodland (30.1)

Partially intact or small stands: River Red Gum riverine forest (7.1); Manna Gum (riverbank) floodplain riparian woodland (16.4); Swamp Paperbark swamp scrub (17.1); Common Tussock-grass–Tall Sedge seasonal wetland (25.5); Common Reed–Cumbungi–Tall Spike-sedge (emergent herbfield) seasonal wetland (25.7)

Remnant, degraded or establishing stands: River Red Gum (alluvial plain) grassy woodland (14.3); Lightwood–Tree Violet cliff/escarpment shrubland (20.5); Swamp Gum swampy woodland (27.1); Rush Sedge–Common Spike-sedge seasonal wetland (25.1)

Critical assemblages or populations: Riverine Forest Critical Conservation Area (Brennans forest). The most intact stand of riverine forest remaining in GM and the only stand supporting faunal values of State significance (nesting parrots). The largest stand of swamp scrub in the Plenty River system (east of Srebenowskis Lake). Along with those at Gravel Quarries Backswamp (site 62) in the Yarra Lowland Hills, the only stand supporting faunal values of State significance (Glossy Grass Skink)

Notable features: Staglianos Lake is part brackish and contains submerged herbfield dominated by Many-fruit Tassel (*Ruppia polycarpa*). This is disjunct from coastal saline wetlands and lagoons.

FAUNAL SIGNIFICANCE: Site 39 Mernda to Yan Yean

Assessment: State—Category 3 (C, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

39^a: 37° 33' x 145° 06'; Yan Yean farm lakes, Plenty River at Reservoir/Dunnetts Road

39^b: 37° 34' x 145° 06'; Plenty River/Barbers Creek junction

A. Cited Zoological Significance

Regional. 39^a: Plenty–Darebin River Red Gum woodlands: Beardsell (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 39^a: Lewin's Rail, Blue-billed Duck, Glossy Grass Skink

Regional. 39^b: Glossy Grass Skink

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

a. Migratory waders

State. 39^a: 5 species at Stagianos Lake on 27 February 1992

b. Waterbirds

State. 39^a: 31 species at Stagianos Lake on 27 February 1992

d. Breeding waterfowl

Regional. 39^a: 7 species at Stagianos Lake on 11 October 1988

f. Breeding migratory insectivores

Regional. 39^b: 9 species including the Sacred Kingfisher, Leaden Flycatcher and White-winged Triller at Brennans in the October 1988 census

g. Breeding parrots

State. 39^b: 9 species including the Purple-crowned Lorikeet, Little Corella, Long-billed Corella, Crimson Rosella and Red-rumped Parrot at Brennans in the October 1988 census

k. Frogs

Regional. 39^{ab}: 6 species including the Striped Marsh Frog at Plenty River/Reservoir Road and Brennans/Watts Lane on 4 October 1988

m. Freshwater fish

Regional. 39^b: Short-finned Eel and Southern Pigmy Perch electrofished from the Plenty River near Barbers Creek on 14 December 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 39^b: over 70 species

b. Native birds

Regional. 39^{ab}: over 50 species

c. Native mammals

Regional. 39^b: 7 species

d. Herpetofauna

Regional. 39^b: 15 species. **39^a**: 8 species

f. Butterflies

Regional. 39^a: 22 species

- E. REPRESENTATIVENESS: Significant Species—reference grid survey
- a. GM critical fauna (R1-R4 species)
Regional. 39^a: 20 species. **39^b:** 15 species
- b. Regionally endangered fauna (R1 species)
Regional. 39^b: 1 species. **Birds:** Peaceful Dove
- c. Regionally vulnerable fauna (R2 species)
State. 39^a: 9 species. **Birds:** Lewin’s Rail, Whiskered Tern, Double-banded Plover, Black-winged Stilt, Greenshank, Curlew Sandpiper, Red-necked Stint, Sharp-tailed Sandpiper. **Reptiles:** Glossy Grass Skink
Regional. 39^b: 3 species. **Birds:** Crested Pigeon, White-throated Gerygone. **Reptiles:** Glossy Grass Skink
- d. Regionally rare fauna (R3 species)
Regional. 39^a: 7 species. **Birds:** Great Crested Grebe, Red-kneed Dotterel, Australasian Shoveler, Pink-eared Duck, Hardhead, Blue-billed Duck, Musk Duck
Regional. 39^b: 3 species. **Birds:** Little Corella, Masked Woodswallow, White-browed Woodswallow
- e. Regionally depleted fauna (R4 species)
Regional. 39^b: 8 species. **Birds:** Latham’s Snipe, Peregrine Falcon, Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Rufous Songlark. **Frogs:** Bibron’s Toadlet. **Fish:** Southern Pigmy Perch
Regional. 39^a: 4 species. **Birds:** Brown Quail, Latham’s Snipe. **Fish:** Southern Pigmy Perch. **Butterflies:** Small Copper
- f. Regionally restricted fauna (R5 species)
Regional. 39^a: 12 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Australian Shelduck, Olive Whistler. **Frogs:** Striped Marsh Frog. **Butterflies:** Phigalia Skipper, Bank’s Brown, Meadow Argus, Dark Purple Azure
Regional. 39^b: 10 species. **Birds:** Cattle Egret, Little Eagle, Australian Hobby, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, White-winged Chough. **Reptiles:** Tussock Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad
- g. Nesting birds of prey/parrots
Regional. 39^b: Brennans forest census: Brown Goshawk (October 88/89), Purple-crowned Lorikeet (October 88), Little Lorikeet (October 89), Little Corella (October 88/89), Long-billed Corella (October 88). Old Whittlesea railway census: Little Corella (October 88)
- F. POPULATION DENSITY: Viability and Abundance—point census
- a. International migratory birds
Regional. 39^a: 18 at Staglianos Lake on 27 February 1992
- b. Rare or threatened fauna
Regional. 39^a: 5 Glossy Grass Skinks from a 60-minute search by the Plenty River east of Srebenowskis Lake on 4 November 1988
- c. Waterfowl
Regional. 39^a: 262 of 15 species at Staglianos Lake on 27 February 1992
- g. Rare/restricted colonial fauna
Regional. 39^a: breeding colony of Nankeen Night Herons on the Plenty River north of Arthurs Creek Road
Regional. 39^b: feeding flock of 120 Sulphur-crested Cockatoo, Long-billed Corella, Galah and Little Corella at Barbers Creek on 8 November 1988

j. Electrofishing rate

Regional. 39^b: 200 Southern Pigmy Perch from the Plenty River downstream of Barbers Creek on 14 December 1988

l. Regionally vulnerable fauna (R2 species)

Regional. 39^a: 10 Sharp-tailed Sandpiper at Staglianos Lake on 27 February 1992

m. Regionally rare fauna (R3 species)

Regional. 39^a: 20 Hardhead, 6 Pink-eared Duck and 7 Australasian Shoveler at Staglianos Lake on 27 February 1992

Regional. 39^b: 10 Little Corella (see *Fg*)

n. Regionally depleted fauna (R4 species)

Regional. 39^b: 200 Southern Pigmy Perch (see *Fj*)

o. Regionally restricted fauna (R5 species)

Regional. 39^b: 20 Long-billed Corella (see *Fg*)

Outlook

Faunal values are diminishing under current management.

FAUNA

Rare or Threatened Fauna

Bc **39^a: Lewin's Rail.** One flushed from Common Tussock-grass–Tall Sedge seasonal wetland (25.5) to the cover of Swamp Paperbark swamp scrub (17.1) nearer the Plenty River behind Srebenowskis on 29 September 1988.

Bc **39^a: Blue-billed Duck.** Pair at Staglianos Lake on 27 February 1992. The lake supports an extensive submerged herbfield (26.1). The birds were diving for the foliage and ripened fruit of Many-fruit Tassel. They also consume equal volumes of invertebrates.

Bc **39^{ab}: Glossy Grass Skink.** This species is the most common lizard in Swamp Paperbark swamp scrub (17.1) along the Plenty River between Srebenowskis Lake and the Toorourrong–Yan Yean Aqueduct overflow at Dunnetts Road. The lizard inhabits piles of branch debris above the flood line. Food supply in the form of shell-shrimps and freshwater shrimps is abundant in the damp litter amongst the branches. Southern Water Skinks inhabit the ribbon of Manna Gum floodplain riparian woodland (16.4) along the river.

A small population of Glossy Grass Skinks persists in River Red Gum (plains) drainage line woodland (30.1) along the lower Barbers Creek at the old Whittlesea railway bridge. Swamp Paperbarks have been cleared from this section. They live under old railway sleepers and fallen bridge trestles. The Tussock Skink occurs on the volcanic plains to the south of the bridge. This is the only location in NEM where the Glossy Grass Skink and the closely related Tussock Skink were both located. Protection of the floodplain paperbark scrub is imperative if the Glossy Grass Skink is to survive.

Critical Assemblages or Populations

Ca/Ec **39^a: Highest diversity of international migratory waders in NEM at Staglianos Lake.** Eighteen birds of five species including the Greenshank (1), Red-necked Stint (2), Curlew Sandpiper (2), Sharp-tailed Sandpiper (10) and Double-banded Plover (3) were present on the extensive fringing mudflats of Staglianos Lake on 27 February 1992. The stint, sandpipers and Greenshank are spring–summer migrants from breeding grounds in the northern hemisphere. These are protected under international migratory bird treaties.

The Double-banded Plover is an autumn–winter migrant from breeding grounds in New Zealand. While not formally protected under treaty, it has a small total population size and the wetlands of southern Australia are considered critical for the species in a global context. The Double-banded Plovers seen at Staglianos Lake were in adult breeding plumage with a second breast bar. Small numbers arrive in Australia from early February, but most arrive during March–April. The lake was not visited at this later time and it is possible that greater numbers visit the shores.

Staglianos Lake is the most important wetland for international migratory waders in NEM. It is also important for Australian migratory waders including the Black-winged Stilt (*Ec*; pair on 11 October 1988) and Red-kneed Dotterel (*Ed*; pair on 27 February 1992). There are large rocks in the shallows and an old roadway and fenceline that bisects from east to west for birds to roost safely. Invertebrate rich mudflats are exposed as the water recedes in late summer–autumn. Staglianos Lake and Towts Swamp at Glenvale (site 37) provide late summer freshwater stop-overs for migratory waders on their return flight from the southern Victorian coast (e.g. on route from Corner Inlet) to their northern hemisphere breeding grounds.

- Cb* **39^a: High diversity of waterbirds—Staglianos Lake census, February 1992.** Thirty one waterbird species were recorded at Staglianos Lake in a 60-minute census on 27 February 1992. There were 262 individuals of 15 species of waterfowl and 18 individuals of five species of international migratory waders. Notable waterbirds included the Great Crested Grebe (2), Australian Pelican (1), Red-kneed Dotterel (2), migratory waders (see preceding paragraphs), Yellow-billed Spoonbill (6), Great Egret (2), Nankeen Night Heron (4), Blue-billed Duck (2), Hardhead (20), Australian Shelduck (7), Pink-eared Duck (6), Australasian Shoveler (7) and Musk Duck (4).
- Cg* **39^b: High diversity of nesting parrots at Brennans forest.** Nine species including the Purple-crowned Lorikeet, Little Corella, Long-billed Corella, Crimson Rosella and Red-rumped Parrot were recorded nesting during the October 1988 census. The Little Lorikeet was also recorded nesting in October 1989. The Purple-crowned Lorikeet was absent in 1989. The unusual occurrence of a Little Corella breeding with a Long-billed Corella was observed in 1988.

Other Significant Fauna

Birds

- Eb* **39^b: Peaceful Dove.** Pair present in River Red Gum riverine forest (7.1) on the bird census plots to the east of the Plenty River at Brennans forest on 23 October 1989. They occur in River Red Gum riverine forests in the Murray and Goulburn river valleys but have not been recorded in River Red Gum grassy woodland in GM. Other birds associated with riverine forest include the Superb Parrot and Blue-faced Honeyeater (both locally extinct) and Red-backed Kingfisher (one sighting in NEM, 3 km to the north at Dunnetts Road Swamp). The riverine forest on Brennans is important in a biogeographic context as it provides a cameo of a faunal habitat characteristic of northern Victoria, virtually eliminated in southern Victoria. Peaceful Doves were recorded breeding in Snow Gum grassy woodland (14.7) nearby at the Yan Yean Reservoir Reference Area in October 1987.
- Ec* **39^b: Crested Pigeon.** Pair present in River Red Gum riverine forest (7.1) on the bird census plots at Brennans forest on 28 October 1988. Single bird also observed on 24 October 1989.
- Ec* **39^a: Whiskered Terns over the lakes in October 1988.** Four were present at Srebenowskis Lake over the last week of October 1988. Two were also seen over Staglianos Lake. They are spring–summer migrants from northern Australia and New Guinea. Fifty were seen at the Yan Yean swamps and lakes in the drought winter of 1982. In wet years influxes also occur and they remain in the district for longer periods. At Srebenowskis Lake the terns were skimming and occasionally diving into the water, presumably for tadpoles, small fish and crustaceans.
- Ec* **39^b: White-throated Gerygone.** A pair arrived on 23 October 1989 in the bird census plots amongst River Red Gum riverine forest to the east of the Plenty River at Brennans forest. The male called continuously during the census over the following days and the pair had commenced nest building on the 30 October 1989. This is the most significant stand of riverine forest remaining in GM and was the only stand of River Red Gum where this or the Leaden Flycatcher (see *Ee*) have been recorded in NEM. These species are mainly recorded in the foothills in gully woodland, box–stringybark woodland or Yellow Box–Candlebark grassy woodland. They occur in River Red Gum riverine forests in the Murray and Goulburn River valleys.
- Ed* **39^a: Regionally rare waterfowl at Staglianos Lake.** Species include the Great Crested Grebe, Australasian Shoveler, Pink-eared Duck, Hardhead, Blue-billed Duck (see *Bc*) and Musk Duck. Two hundred and sixty-two individuals of 15 species of waterfowl were present on 27 February 1992. These included 30 Hoary-headed Grebe, 6 Australasian Grebe, 2 Great Crested Grebe, 30 Eurasian Coot, 20 Australian Wood Duck, 30 Black Swan, 40 Grey Teal, 8 Chestnut Teal, 7 Australian Shelduck, 50 Pacific Black Duck, 6 Pink-eared Duck, 20 Hardhead, 7 Australasian Shoveler, 2 Blue-billed Duck and 4 Musk Duck. Seven waterfowl species (30 pair) were breeding on 11 October 1988. These were the

Australasian Grebe (1 pair), Hoary-headed Grebe (5 pair), Black Swan (3 pair), Pacific Black Duck (5 pair), Grey Teal (5 pair), Chestnut Teal (1 pair) and Eurasian Coot (10 pair).

The permanent open water and fruit/foilage of submerged herbfield (Many-fruit Tassel) at Staglianos Lake provide feeding areas for the waterfowl. Staglianos Lake and Srebenowskis Lake act as stop-over points for waterbirds including the Australian Pelican and Australasian Shoveler moving from Yan Yean Reservoir. A pair of shovelers was present at Srebenowskis Lake on 25 October 1988.

Staglianos Lake is one of the most important areas for waterfowl in NEM. It serves the dual role of providing waterbird habitat and irrigation water and serves as a fine model for the establishment of open water wetlands. Most of the artificial waterbodies on small farms in the district contain deep water and little shallows, aquatic vegetation or safe roosting areas. These are usually of little value to waterbirds.

Ed **39^b: Masked and White-browed Woodswallows.** A mixed flock of 10 of the former and 50 of the latter arrived at the Brennans forest bird census plots of River Red Gum riverine forest (7.1) in the late afternoon of 26 October 1988. Several pair of White-browed Woodswallows stayed to breed while the Masked Woodswallow moved on.

Ee **39^a: Latham's Snipe and Brown Quail in floodplain herbfield on the Plenty River floodplain.** Two Brown Quail were seen on the mudflat edge of the river under Swamp Paperbark swamp scrub (17.1) to the east of Srebenowskis Lake on 29 September 1988. Two Latham's Snipe were flushed from a swale of Common Tussock-grass–Tall Sedge seasonal wetland (25.5) along the drainage line connecting the lake to the river. Snipe were also flushed at the River Red Gum bird census plot in Brennans forest in October 1988. In wet years they are widespread in the grassy meadows along the floodplain.

Ee **39^b: Leaden Flycatcher and White-winged Triller.** Both recorded in River Red Gum riverine forest (7.1) at the Brennans forest bird census plots. The flycatcher nested in October 1988 (see *Ec*; White-throated Gerygone) while the triller nested in October 1988 and 1989.

Ef **39^a: Olive Whistler.** The Olive Whistler and Rufous Fantail were seen in Swamp Paperbark swamp scrub (17.1) behind Srebenowskis, possibly while in passage.

Fg **39^a: Breeding colony of Nankeen Night Herons.** A small colony of three pair with unfledged young was located in Swamp Paperbark swamp scrub (17.1) by the Plenty River between the Yan Yean–Arthurs Creek Road and Reservoir Road on 16 December 1991. The nests were a loose construction of twigs, wedged into forks of the paperbarks. Four birds (2 adults and two juveniles) were recorded roosting by Reservoir Road on 27 February 1992. The nearby Staglianos Lake contains extensive areas of submerged herbfield and populations of yabbies and Southern Pigmy Perch, which are food for herons.

Butterflies

39^a: Plenty River–Reservoir Road to Dunnetts Road. Twenty-two species were recorded in Swamp Paperbark swamp scrub (17.1) along the floodplain at Reservoir Road and near the Toorourrong–Yan Yean overflow on Dunnetts Road. Over half of these were located in the flowering Swamp Paperbarks in November 1992. Surveys were also conducted in January 1993 and April 1993. Significant species: Bright Shield Skipper, Phigalia Skipper (feeding in the flowering paperbarks on 6 November) and Phigaliodes Skipper, Symmomus Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure and Small Copper.

Freshwater fish

Electrofishing Survey: Plenty River–200 m south of Barbers Creek

Map reference. 7922 334388. **Altitude.** 170 m. **Survey date.** 14 December 1988

Vegetation. Instream: Submerged (extensive) and emergent herbfield. Bank: Manna Gum floodplain riparian woodland (16.4; poor condition). Frontage: River Red Gum (volcanic plain) grassy woodland (14.1; west side in poor condition); River Red Gum (alluvial plain) grassy woodland (14.3; east side and eliminated); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; poor condition and weed invaded; basalt on west side of river)

Physical Features:

Pools

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). 7 m wide by 0.8 m deep by 100 m long

Riffles

Substrate. Pebbles, silt and sand on alluvial clay base

Flow (mid-summer normal): Size. 2.0 m wide by 5 m deep. **Velocity.** 0.4 m/sec. **Rate.** 9.5 ML/day

Water quality

Summer: Temperature. 23°C. **Conductivity.** 450 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (6); migratory sub-adult. Southern Pigmy Perch (200); likely breeding resident

Alien species numbers/status. Goldfish (1); likely breeding resident. Mosquito Fish (8); likely breeding resident.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. Intact habitat links to the Yan Yean Reservoir and Plantations site, Dunnetts Road Swamp–Plenty River Cades Road site, Fenwick and Surrounds site and Mernda site.

Plenty Valley River Red Gum bird census (see Volume 1). The Mernda to Yan Yean site contains the most severe outbreaks of leaf defoliation, dieback and death of mature River Red Gums observed in the Plenty Valley. The dieback is caused by defoliating insects (psyllids and skeletonisers). Loss of shrubland habitat and fragmentation of stands has reduced the populations of insectivorous birds.

Plenty–Merri River Red Gum Protection Zone. See volume 1.

Strengthen Strategic Habitat Link. All River Red Gum on the floodplain of the Plenty River (mostly contained in this unit) needs to be protected and managed for conservation purposes. It is the only contiguous habitat link between the Plenty Upland Hills and the Plenty Lowland Volcanic Plains. The stand of riverine forest on Brennans is small and fragmented and needs to be protected and linked through revegetation to stands on the west side of the river. The latter are more thinned and degraded but link further west to the extensive and significant grassy woodland sites of the Darebin and Barbers Creeks.

Riverine Forest Critical Conservation Area. The small stand of River Red Gum riverine forest opposite the mouth of Barbers Creek and to the east of the Plenty River (Brennans forest) is of biogeographical significance for flora and fauna. It is the only surviving representative of this habitat, now threatened with regional extinction in GM. It was once part of an extensive area of riverine forest which extended from the confluence of the Barbers Creek west to the old Whittlesea railway and north to the Arthurs Creek Road. Regeneration of a more substantial and viable stand of riverine forest and its understorey in this section of the floodplain has high priority amongst regional conservation objectives. vegetation. Grazing exclusion areas need to be established, ideally through the support of Government agencies, Whittlesea Council and a landowner River Red Gum land protection group.

 Regional Hydrological Strategy

Fragmentation and degradation of wetland habitat and faunal populations. The site is now composed of degraded and fragmented stands of native vegetation, the present natural area of wetland vegetation probably less than 10% of that of the original (Author pers. obs.). This loss in extent and degree of fragmentation of the marshland is consistent with that experienced for shallow freshwater marsh systems elsewhere in the southern lowlands of Victoria (Corrick 1982), and more particularly those dominated by Swamp Paperbark in coastal south-eastern Victoria (Frood & Calder 1987). The paperbark swamps and their remnant ground fauna populations (e.g. Glossy Grass Skink) are now isolated from the nearest occurrences to the east and south-east of Melbourne. Swamp Paperbark and the Glossy Grass Skink do not occur west of the Plenty River catchment in GM. Populations of the skink in the site are fragmented, depleted and at risk of elimination. See the Dunnetts Road Swamp–Plenty River site.

Electrofishing site. There is inadequate riparian and frontage woodland and scrub vegetation. Severe trampling and grazing by livestock on upper creek escarpments has resulted in gully erosion and bank slumping. The frontage woodlands have been cleared and livestock grazing has removed the native vegetation from the bank. The grazing and bank disturbance has led to Gorse infestations.

Swamp Paperbark protection/streamway conservation management.

Swamp Paperbark swamp scrub is one of the most heavily cleared and degraded habitats in NEM. All stands need to be protected. This habitat occurs along the streamway of the Plenty River from north of the Yan Yean–Arthurs Creek Road to north of the Toorourrong–Yan Yean Aqueduct overflow on Dunnetts Road. The streamway is determined as the normal floodwater inundation area and includes all existing stands of Swamp Paperbark. It also includes native species dominated seasonal wetland. Swamp Paperbark dominated swamps near Melbourne and throughout Victoria are mostly confined to relictual stands. The largest and most intact stand (about 2 ha) in the Plenty River system occurs to the east of Srebenowskis Lake, north of the Yan Yean–Arthurs Creek Road. The herbfield under the scrub has been more protected from grazing than stands in sections to the north of Reservoir Road.

Acquisition of the streamway as public open space managed primarily for nature conservation or the encouragement of conservation management by landowners (e.g. negotiation of conservation covenants) is required. Management as a conservation area would require fencing to facilitate the regeneration of a continuous link of Swamp Paperbark through the site. There is evidence of regeneration of Swamp Paperbark and a core of native swampland species in areas protected from high grazing pressure. The streamway has a high potential for rehabilitation due to the biological diversity still present. Indigenous species replanting to enhance the faunal habitat link along the river is urgently required.

VOLUME 4

LOWLAND HILLS

Plenty Lowland Hills (PLH)

PLH A. Plenty Gorge

- Site 40. Yarrambat–Morang Wetlands
- Site 41. Kurrak Road
- Site 42. Plenty–Janefield
- Site 43. Tanunda Wetlands

PLH B. Greensborough

- Site 44. Greenhills
- Site 45. Yallambie to Greensborough

PLH C. Diamond Creek

- Site 46. Diamond Creek
- Site 47. Plenty
- Site 48. St Helena

PLH D. Eltham

- Site 49. Eltham Copper Butterfly Reserves
- Site 50. Eltham North
- Site 51. Eltham Township
- Site 52. Meruka Park
- Site 53. Wombat Drive–Piper Crescent Research

Yarra Lowland Hills (YLH)

YLH A. North Warrandyte–Research

- Site 54. Pretty Hill–Eltham College
- Site 55. Kalbar Road–Research Township
- Site 56. Stony Creek–Pigeon Bank–Laughing Waters Creek

YLH B. Yarra River Diamond Creek to Jumping Creek

- Site 57. Pettys–Sweeneys–Paddles–Morrison–Glynns
- Site 58. Pound Bend–Fourth Hill–The Common–Black Flat

YLH C. Yarra River Jumping Creek to Yering Flats

- Site 59. Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands
- Site 60. Round the Bend Cooperative–Maroondah Aqueduct
- Site 61. Sugarloaf Reservoir
- Site 62. Yering Gorge–Yering Flats

YLH D. Watsons Creek Lower Reaches

- Site 63. Henley Road to Watsons Creek
- Site 64. Watsons Creek to Christmas Hills

Nilumbik Lowland Hills (NLH)

NLH A. Arthurs Creek Hurstbridge to Strathewen

- Site 65. Arthurs Creek to Strathewen
- Site 66. Hurstbridge to Arthurs Creek
- NLH B. Cottles Bridge
 - Site 67. Cottles Bridge–Strathewen Road–Shaws Road
 - Site 68. Dunmoochin
 - Site 69. Pittles Paddock
- NLH C Hurstbridge
 - Site 70. Cherry Tree Creek
 - Site 71. Haleys Gully Road Red Ironbarks
 - Site 72. Hurstbridge to Kangaroo Ground Red Ironbarks
 - Site 73. Plenty River–Diamond Creek Link
 - Site 74. Wattle Glen to Hurstbridge
- NLH D. Diamond Creek Hurstbridge to St Andrews
 - Site 75. Cottles Bridge to St Andrews
 - Site 76. Red Shirt Gully
- NLH E. Pantan Hill–Long Gully
 - Site 77. Kangaroo Ground–St Andrews Road Red Ironbarks
 - Site 78. Long Gully Link

HABITATS of the Lowland Hills

For detailed descriptions refer to Beardsell (in prep.): Yarra–Plenty Catchment. Flora, Vegetation Community Survey and Sites of Botanical Significance. VOLUME 1. Plenty Gorge Park. VOLUME 2. Yarra Valley Park. VOLUME 3. Warrandyte State Park to One Tree Hill.

4.2. Damp Sclerophyll Forest—sheltered mountain slope

Conservation status: regionally secure

Partially intact or small stands: 62^a

Distribution: localised in YLH C at Yering Backswamp

Landforms: foothill—sheltered hill-slopes and gullies of ephemeral streams above 200 m elevation

Canopy: Messmate; with Narrow-leaf Peppermint and Manna Gum; 30–40 m tall and 30–40% cover

5.1. Riparian Forest—riverbank

Conservation status: regionally depleted

Reference stands: 57^{bd}, 59^b, 62^a

Relatively intact and extensive stands: 57^{ce}, 58^c, 59^{acd}

Distribution: restricted in YLH B/C (Yarra River)

Landforms: foothill—riverbank

Canopy: Manna Gum; with Yellow Box; 20–30 m tall and 20–30% cover

5.2. Riparian Forest—floodplain terrace

Conservation status: regionally depleted

Reference stands: 57^d, 59^b, 64^b

Relatively intact and extensive stands: 46^d, 57^e, 58^c, 59^b, 62^a, 75^a

Distribution: restricted in PLH, YLH and NLH

Landforms: foothill—first order (Yarra River) and second order (Diamond and Watsons Creeks) stream floodplain terraces

Canopy: Manna Gum; Yellow Box, Messmate, Swamp Gum and Narrow-leaf Peppermint; 20–30 m tall and 20–30% cover

5.3. Riparian Forest—creek

Conservation status: regionally depleted

Reference stands: 64^b, 75^a

Relatively intact and extensive stands: 46^d, 59^a, 63^{bd}, 64^a, 75^b

Distribution: restricted in YLH and NLH; localised in PLH

Landforms: foothill—creeks

Canopy: Manna Gum; with Yellow Box; 20–30 m tall and 20–30% cover

6.1. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally depleted

Reference stands: 59^b, 60^a, 68^a, 72^a, 77^a

Relatively intact and extensive stands: 41^a, 54^a, 56^{be}, 57^a, 59^e, 62^a, 63^b, 64^b, 69^a, 75^{ab}, 76^a, 78^{abc}

Distribution: widespread in YLH and NLH and restricted in PLH

Landforms: foothill—sheltered hill-slopes and valleys

Red Stringybark; with Long-leaf Box, Red Box and Narrow-leaf Peppermint (and Yellow Box and Candlebark where flanking 31.1)

6.2. Herb-rich Foothill Forest—sheltered escarpment

Conservation status: regionally depleted

Reference stands: 59^b, 62^a, 64^b, 75^a

Relatively intact and extensive stands: 41^a, 57^e, 59^{acd}, 75^b

Partially intact or small stands: 54^a

Distribution: restricted in YLH, NLH and PLH

Landforms: foothill—sheltered stream escarpments

Canopy: **Narrow-leaf Peppermint**; with Long-leaf Box, Yellow Box, Red Stringybark, Messmate, Red Box and Candlebark; 15–20 m tall and 30–40% cover

6.3. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally depleted

Reference stands: nil

Relatively intact and extensive stands: 59^b, 60^a, 62^a

Distribution: restricted in YLH C and NLH

Landforms: foothill—sheltered hill-slopes

Canopy: **Messmate**; with Long-leaf Box, Swamp Gum and Narrow-leaf Peppermint; 20–30 m tall and 30–40% cover

10.1. Gully Woodland—creek

Conservation status: regionally threatened

Reference stands: 58^c, 59^d

Relatively intact and extensive stands: 41^a, 42^a, 43^a, 56^b, 57^a, 78^{ab}

Partially intact or small stands: 54^a

Distribution: restricted in PLH, YLH and NLH

Landforms: foothill—minor streams

Canopy: **Manna Gum**; with Yellow Box, Swamp Gum, Narrow-leaf Peppermint and Candlebark; 15–25 m tall and 10–25% cover

10.2. Gully Woodland—sheltered valley/gully

Conservation status: regionally depleted

Reference stands: 59^b

Relatively intact and extensive stands: 56^b, 60^a, 62^a, 64^b, 72^a, 75^a, 76^a, 77^a, 78^{ac}

Distribution: restricted in YLH and NLH

Landforms: foothill—gullies, sheltered valleys and upper floodplains of creeks

Canopy: **Messmate**; with Mountain Swamp Gum, Swamp Gum, Narrow-leaf Peppermint and Manna Gum; occasional stands of Green Scentbark (*E. fulgens*; e.g. Watery Gully Creek); the reason for the usually exclusive occurrence of Swamp Gum or Mountain Swamp Gum is not clearly understood; Mountain Swamp Gum appears more dependent on adequate drainage in winter (less tolerant of water-logging) but requires more water over summer (mainly upper stream floodplains and broad valleys) than Swamp Gum (mainly gullies); either often dominates over Messmate, but the sub-community is characterised by the latter always being present; 15–30 m tall and 20–30% cover

10.3. Gully Woodland—sheltered valley

Conservation status: regionally threatened

Reference stands: 42^b, 57^a, 59^e

Relatively intact and extensive stands: 54^a,

Distribution: widespread in PLH, YLH and NLH

Landforms: foothill—sheltered gullies and valleys

Canopy: **Swamp Gum**; with Yellow Box, Narrow-leaf Peppermint and Manna Gum; occasional stands of Yarra Gum; 12–20 m tall and 10–20% cover

11.1. Box–Stringybark Woodland—hill-crest

Conservation status: regionally depleted

Reference stands: 68^a

Relatively intact and extensive stands: 41^b, 47^{ab}, 54^a, 59^{be}, 64^b, 69^a, 72^a, 75^a, 76^a, 77^{ab}, 78^a

Distribution: widespread in PLH, YLH and NLH

Landforms: foothill—exposed hill-slopes and hill-crests (Silurian mudstone/siltstone)

Canopy: Red Box–Red Stringybark; with Long-leaf Box; 10–15 m tall and 20–30% cover

11.2. Box–Stringybark Woodland—hill-crest/spur

Conservation status: regionally threatened

Reference stands: 55^a, 57^a

Relatively intact and extensive stands: 49^b, 69^a

Partially intact or small stands: 54^a

Distribution: localised in PLH, YLH and NLH

Landforms: foothill—exposed hill-slopes, hill-crests and river spurs (Silurian sandstone); fragmented and degraded

Canopy: Yellow Box–Red Stringybark; with Long-leaf Box and Candlebark; 10–15 m tall and 20–30% cover

11.3. Box–Stringybark Woodland—exposed valley

Conservation status: regionally threatened

Reference stands: 68^a, 76^a

Relatively intact and extensive stands: 54^a, 63^a, 64^b, 75^a,

Partially intact or small stands: 41^b, 42^c, 56^e, 69^a, 72^{ab}, 75^{bc}, 78^{ac},

Distribution: restricted in NLH and PLH and localised in YLH

Landforms: foothill—exposed valleys (Silurian mudstone/siltstone); heavily fragmented

Canopy: Red Stringybark; with Long-leaf Box, Yellow Box, Red Box, Narrow-leaf Peppermint and Candlebark; 15–20 m tall and 20–30% cover

12.1. Box–Ironbark Woodland—hill-crest

Conservation status: regionally threatened/disjunct

Reference stands: 60^a, 77^a

Partially intact or small stands: 61^a, 62^a, 64^b, 77^b

Distribution: restricted in YLH and NLH

Landforms: hill-crests and hill-slopes; the sub-community can occur on more sheltered situations than 12.2; at section at Boomers Reserve occupies an area of impeded drainage in a headwater saddle of a gully

Canopy: Red Ironbark; with Long-leaf Box, Red Stringybark, Messmate and Red Box; 15–25 m tall and 20–30% cover

12.2. Box–Ironbark Woodland—hill-crest/spur

Conservation status: regionally disjunct

Reference stands: 72^a

Relatively intact and extensive stands: 40^b

Partially intact or small stands: 72^b, 73^a

Distribution: disjunct in PLH A and NLH C

Landforms: river spurs and escarpments (Plenty River), hill-crests and exposed hill-slopes

Canopy: Red Ironbark–Yellow Gum; with Long-leaf Box, Red Stringybark and Red Box; 10–20 m tall and 15–25% cover

12.3. Box–Ironbark Woodland—spur/hill-crest

Conservation status: regionally threatened

Reference stands: 42^b

Relatively intact and extensive stands: 42^{ac}

Partially intact or small stands: 44^a

Distribution: restricted in PLH

Landforms: river spurs and escarpments (Plenty River) and hill-crests

Canopy: Yellow Gum–Red Box; with Red Stringybark; 10–15 m tall and 15–20% cover

13.1. Escarpment Woodland—sheltered

Conservation status: regionally threatened

Reference stands: 42^b, 57^{ad}

Relatively intact and extensive stands: 41^c, 43^a

Partially intact or small stands:

Distribution: restricted in PLH A and YLH B

Landforms: sheltered escarpments of the Yarra and Plenty River

Canopy: Long-leaf Box–Manna Gum; with Red Stringybark, Yellow Box and Narrow-leaf Peppermint; 15–20 m tall and 15–25% cover

13.2. Escarpment Woodland—exposed

Conservation status: regionally threatened

Reference stands: 42^b, 57^d

Relatively intact and extensive stands: 42^d

Distribution: localised in PLH A and YLH B

Landforms: exposed bluffs, spurs and escarpments of the Yarra and Plenty River

Canopy: Yellow Box; with Long-leaf Box and Manna Gum; 10–15 m tall and 15–20% cover

13.3. Escarpment Woodland—exposed

Conservation status: regionally depleted

Reference stands: 42^a

Relatively intact and extensive stands: 41^a, 57^b, 58^c, 59^{bcd}, 62^a

Distribution: restricted in PLH A and YLH B

Landforms: exposed bluffs, spurs and escarpments of the Yarra and Plenty River

Canopy: Red Box; with Long-leaf Box, Red Stringybark (Yellow Gum in the Plenty Gorge and Narrow-leaf Peppermint along the Yarra); 10–15 m tall and 20–25% cover

14.1. Grassy Woodland—volcanic plain

Conservation status: regionally threatened

Reference stands: 42^a

Partially intact or small stands: 40^b

Distribution: localised in PLH A

Landforms: stony plains (Quaternary volcanics)

Canopy: River Red Gum; with Long-leaf Box and Yellow Box; 12–15 m tall and 10–20% cover

14.2. Grassy Woodland—volcanic capping

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 40^b, 41^{ac}, 42^b

Degraded, remnant or establishing stands: 42^d, 54^a

Distribution: localised in PLH A (eliminated from PLH D) and YLH A

Landforms: Tertiary volcanic cappings and Quaternary volcanic escarpments

Canopy: Yellow Box–Hill Manna Gum; with Long-leaf Box (occasional Silver Bundy); 12–15 m tall and 15–25% cover

14.3. Grassy Woodland—alluvial plain

Conservation status: regionally threatened**Reference/extensive/small stands:** nil**Remnant, degraded or establishing stands:** 40^c, 43^a**Distribution:** restricted in PLH A**Landforms:** foothill—plain-slopes**Canopy:** River Red Gum; with Yellow Box; 15–25 m tall and 10–25% cover

14.5. Grassy Woodland—plain-slope

Conservation status: regionally threatened**Reference stands:** nil**Relatively intact and extensive stands:** 46^c**Partially intact or small stands:** 41^b**Distribution:** restricted in PLH and NLH C**Landforms:** foothill—plain-slopes; degraded and fragmented**Canopy:** Blakely's Red Gum; with River Red Gum, Long-leaf Box, Yellow Box, Red Box and Candlebark; 15–20 m tall and 10–20% cover

14.6. Grassy Woodland—valley

Conservation status: regionally threatened**Reference stands:** 57^d**Relatively intact and extensive stands:** 69a, 75c**Partially intact or small stands:** 52a, 64ab, 66d, 67c**Degraded, remnant or establishing stands:** 44a, 45ab, 50ab, 51a, 57c, 65a, 66abc, 67b, 74bc**Distribution:** restricted in NLH and localised in PLH and YLH**Landforms:** foothill—broad exposed stream valleys**Canopy:** Yellow Box–Candlebark; with Long-leaf Box, Red Stringybark and Red Box; 15–20 m tall and 20–30% cover

14.7. Grassy Woodland—alluvial flat

Conservation status: regionally threatened and disjunct**Reference/extensive/small stands:** nil**Remnant, degraded or establishing stands:** 60^a**Distribution:** disjunct in YLH C where highly degraded and fragmented; formerly at Sugarloaf Reservoir where inundated apart from scattered trees above north-eastern arm**Landforms:** foothill—alluvial flats**Canopy:** Snow Gum; with Swamp Gum, Candlebark and Yarra Gum; 10–15 m tall and 10–20% cover

15.1. Sand-plain Woodland

Conservation status: regionally threatened/disjunct**Reference stands:** 42^b**Relatively intact and extensive stands:** nil**Partially intact or small stands:** 42^d**Degraded, remnant or establishing stands:** 54^a**Distribution:** disjunct in PLH A and YLH A**Landforms:** Tertiary sand-plain spurs and valleys**Canopy:** Hill Manna Gum; with Long-leaf Box and Yellow Box; 10–15 m tall and 20–30% cover

15.2. Sand-plain Woodland

Conservation status: regionally threatened/disjunct

Reference stands: 42^b

Distribution: disjunct in PLH A

Landforms: Tertiary sand-plain saddle (impeded drainage)

Canopy: Burgan; with Black Wattle, Lightwood and emergent Hill Manna Gum; 5–8 m tall and 30–40% cover

16.4. Floodplain Riparian Woodland—riverbank

Conservation status: regionally depleted

Reference stands: 40^b

Relatively intact and extensive stands: 40^c, 41^{ac}

Partially intact or small stands: 45^{ab}, 62^b

Distribution: restricted in PLH A/B and YLH C

Landforms: riverbanks (Plenty Gorge and Yarra at Yering/Coldstream flats)

Canopy: Manna Gum; 15–20 m tall and 10–20% cover

16.5. Floodplain Riparian Woodland—river terrace

Conservation status: regionally threatened

Reference stands: 42^b

Relatively intact and extensive stands: 41^a, 42^b

Distribution: restricted in PLH A/B

Landforms: river terraces (Plenty Gorge)

Canopy: Manna Gum; with Long-leaf Box, Yellow Box and Red Box; 15 m tall and 15–20% cover

17.1. Swamp Scrub—billabong/river flat

Conservation status: regionally threatened/disjunct

Reference stands: 62^a

Partially intact or small stands: 62^b

Distribution: localised in YLH C; eliminated from PLH C

Landforms: stream floodplains and river billabongs and backswamps

Canopy: Swamp Paperbark; with Burgan and emergent Swamp Gum and Manna Gum; 5–8 m tall and 30–40% cover

18.1. Riparian Scrub—sedimentary rapids

Conservation status: regionally disjunct

Reference stands: 40^{bc}, 57^{be}

Relatively intact and extensive stands: 41^a, 42^a, 57^c, 58^{ac}, 59^{abcd}, 62^a

Distribution: restricted in PLH A and YLH B/C

Landforms: sedimentary river rapids

Canopy: Muttonwood; with Tree Everlasting, Blackwood, Silver Wattle, Hemp Bush, River Bottlebrush, Burgan, Manna Gum (emergent), Mountain Tea-tree (Yarra), Woolly Tea-tree (Plenty), River Lomatia (Yarra), Hazel Pomaderris, Prickly Currant-bush and Tree Violet; 5–8 m tall and 30–50% cover

Instream submerged/floating herbfield: Water-ribbons, Swamp Club-sedge, Lake Eel-grass, Curly Pondweed (Yarra) and Varied Milfoil

Riverbank emergent herbfield: Water Plantain, Stream Club-sedge (Yarra), Marsh Club-sedge (Plenty), Fen Sedge, Flat-fruit Club-sedge, River Club-sedge, Hollow Rush, Green Rush, Australian Sweet-grass, Sword Tussock-grass, Common Reed, Lesser Joyweed, Sea Celery (Plenty), Centella (Yarra), Slender Pennywort, Shield Pennywort (Plenty), Matted Pratia, Swamp Crassula, River Mint, Slender Knotweed, Spotted Knotweed, Hairy Knotweed, Bidgee-widgee, Austral Brooklime (Yarra) and Swamp Mazus

20.2. Cliff/Escarpment Shrubland—sheltered

Conservation status: regionally disjunct

Reference stands: 41^c, 42^b, 59^b

Relatively intact and extensive stands: 40^b, 41^c, 42^a, 57^d 58^a, 59^{cd}

Distribution: restricted in PLH A and YLH B/C

Landforms: sheltered river cliffs

Canopy: **Burgan–Sweet Bursaria**; with Dogwood and Silver Wattle and emergent Long-leaf Box, Red Stringybark and Manna Gum; 2–12 m tall and 30–50% cover

20.4. Cliff/Escarpment Shrubland—exposed

Conservation status: regionally disjunct

Reference stands: 41^c, 57^e

Relatively intact and extensive stands: 40^b, 42^{ab}, 62^a

Partially intact or small stands: 59^{bd}

Distribution: restricted in PLH A and YLH B/C

Landforms: exposed river cliffs

Canopy: **Golden Wattle–Black Wattle**; with Lightwood, Black Wattle, Burgan and Wedge-leaf Hop-bush (Plenty Gorge) and emergent Long-leaf Box, Yellow Gum (Plenty Gorge); Red Stringybark, Red Box and Red Ironbark (Plenty Gorge and Yering Gorge); 2–8 m tall and 20–30% cover

20.5. Cliff/Escarpment Shrubland—volcanic

Conservation status: regionally threatened

Reference stands: 41^c

Relatively intact and extensive stands: 40^b, 41^a, 42^b

Distribution: restricted in PLH A

Landforms: Quaternary volcanic cliffs

Canopy: **Lightwood–Tree Violet**; with Black Wattle, Blackwood and Tree Bursaria and emergent Long-leaf Box, Yellow Box and Hill Manna Gum; 2–10 m tall and 20–30% cover

25.1. Seasonal Wetland—freshwater meadow/alluvial plain

Conservation status: regionally disjunct

Relatively intact and extensive stands: 40^b

Distribution: localised in PLH A (Plenty Gorge)

Landforms: shallow freshwater marsh at an artificial waterbody (shoreline of Wilton Vale Marsh)

Character species: **Rush Sedge–Common Spike-sedge**; with Slender Spike-sedge, Austral Rush, River Swamp Wallaby-grass, Common Tussock-grass, Waterwort, Red Milfoil, White Purslane and Austral Mudwort; 0.5–1 m tall and 40–60%

25.3. Seasonal Wetland—volcanic gilgai/swale

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 42^a

Distribution: localised in PLH A

Landforms: depressions and drainage lines (natural and artificial) in gilgai plains

Canopy: **Brown-back Wallaby-grass**; with Common Spike-sedge, Small Spike-sedge, Common Blown Grass, Common Love-grass, Swamp Isotome, Upright Milfoil; 0.2–0.5 m tall and 40–60% cover

25.4. Seasonal Wetland—floodplain herbfield

Conservation status: regionally disjunct

Reference stands: 42^b

Partially intact or small stands: 41^c

Distribution: disjunct in PLH A (Plenty Gorge; Pilularia Swamp)

Landforms: floodplain terrace swamp

Canopy: Tall Sedge–Soft Bog-sedge; with Common Spike-sedge, Pointed Swamp Wallaby-grass, Common Love-grass, Common Tussock-grass, Swamp Isotome, Upright Milfoil and Running Marsh-flower; 0.2–0.5 m tall and 40–60%; rare coastal variant of the foothills 25.5

25.5. Seasonal Wetland—floodplain herbfield

Conservation status: regionally depleted

Reference stands: 62^a

Relatively intact and extensive stands: 46^a

Partially intact or small stands: 58^a, 59^{abc}, 75^a

Distribution: localised in PLH, YLH and NLH

Landforms: floodplain terrace swamps

Canopy: Sword Tussock-grass–Tall Sedge; with Common Spike-sedge, Joint-leaf Rush, Veined Swamp Wallaby-grass, Common Tussock-grass (dominant away from streams), Australian Sweet-grass, Centella, Varied Raspwort, White Purslane and Upright Milfoil; 0.5–2 m tall and 60–80% cover

25.7. Seasonal Wetland—emergent herbfield

Conservation status: regionally secure

Reference stands: 62^a

Relatively intact and extensive stands: 40^b, 43^a

Partially intact or small stands: 59^b, 74^{ab}

Distribution: restricted in PLH, NLH and YLH

Landforms: deep and shallow freshwater marshes at river billabongs and backswamps (Yarra), floodplain swamps and artificial waterbodies (dams and reservoirs)

Character species: Common Reed–Cumbungi–Tall Spike-sedge; with Common Spike-sedge, Pale Rush, Floating Pondweed, Water-ribbons, Swamp Crassula, Upright Milfoil, Slender Knotweed and Small River Buttercup (Yarra); 0.5–3 m tall and 60–80% cover

26.1. Permanent Wetland—submerged/floating herbfield

Conservation status: regionally secure

Reference stands: 62^a

Relatively intact and extensive stands: 40^b

Distribution: restricted in PLH, YLH and NLH

Landforms: deep and shallow freshwater marshes at artificial waterbodies (dams and reservoirs)

Character species: Blunt Pondweed; with Riccia (*R. duplex*), Pacific Azolla, Ferny Azolla, Lake Eel-grass (Plenty Gorge), Common Duckweed, Fennel Pondweed (Plenty Gorge), Red Milfoil (Plenty Gorge) and Yellow Bladderwort; 10–50% cover

27.1. Swampy Woodland—floodplain

Conservation status: regionally threatened

Reference, relatively intact and extensive stands: nil

Partially intact or small stands: 62^a

Remnant, degraded or establishing stands: 59^a, 62^b

Distribution: YLH C, where eliminated apart from a small, partially cleared (but regenerating) stand at the rear of the ingrown meander south of Yering Backswamp

Landforms: seasonally waterlogged flats on the floodplains of streams (formerly extensive areas associated with the Middle Yarra flats between Homestead Road and Victoria Road)

Canopy: Swamp Gum; with Blackwood, Yellow Box, Messmate, Candlebark, Narrow-leaf Peppermint and Yarra Gum; 15–20 m tall and 10–20% cover.

28.1. Swampy Riparian Woodland—creek

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 59^f**Distribution:** YLH C; remnant strata along Brushy Creek**Landforms:** streams entering Yarra River adjoining the study area (e.g. Olinda Creek, Brushy Creek and Koonung Creek)**Canopy: Swamp Gum;** with Blackwood, Yarra Gum and Swamp Paperbark; 12–15 m tall and 10–20% cover.

30.1. Drainage Line Woodland—plains

Conservation status: regionally threatened**Reference or relatively intact and extensive stands:** nil**Partially intact or small stands:** 40^b, 41^b**Distribution:** restricted in PLH A (eliminated from PLH C)**Landforms:** creeks and drainage lines; degraded and fragmented**Canopy: River Red Gum;** with Yellow Box, Swamp Gum and Narrow-leaf Peppermint (Hill Manna Gum on the Tertiary sand-plain and occasional Yarra Gum, Lightwood, Black Wattle and Swamp Paperbark); 15–20 m tall and 10–20% cover

31.1. Valley Forest

Conservation status: regionally depleted**Reference stands:** 59^b**Relatively intact and extensive stands:** 57^a, 59^e, 60^a, 63^b, 64^b, 68^a, 75^a, 76^a, 78^{ab}**Partially intact or small stands:** 46^{de}, 47^a, 49^b, 54^a, 56^{bc}, 57^d, 58^{abd}, 59^{ad}, 63^{acde}, 64^a, 65^a, 66^b, 67^a, 69^a, 70^a, 72^a, 73^b, 74^{ab}, 75^b, 77^{ab}, 78^c**Degraded, remnant or establishing stands:** 44^a, 47^b, 48^{abc}, 53^a, 54^b, 55^{ab}, 56^{ade}, 57^{bce}, 58^c, 62^a, 67^c, 71^{ab}, 72^b, 73^{ac}, 74^c**Distribution:** widespread in YLH and NLH and restricted in PLH; mainly as partially intact or degraded stands**Landforms:** foothill—sheltered valleys**Canopy: Yellow Box–Candlebark;** with Blackwood, Long-leaf Box, Red Stringybark, Messmate and Narrow-leaf Peppermint; 15–20 m tall and 25–40% cover

GEOLOGICAL and LANDFORM/SOIL TYPES of the Lowland Hills

Silurian Siltstone/Mudstone

Distribution: PLH A (east of the Plenty River from Yarrambat Park to Civic Drive); PLH B (north-west and south-east sections of the unit); PLH C (associated with the Templestowe Anticline east of St Helena Road and a small occurrence on the ridgeline of the Old Diamond Creek Road); PLH D

YLH A; YLH B (east of the Mullum Mullum Creek); YLH C (dominant geology downstream of Watsons Creek); YLH D (highly upfolded Warrandyte anticlinorium near the Yarra River in the south-west of the unit, where the dominant exposure is the deeper lying mudstone; it extends north along an anticline following Ridge Road; the dominant exposure in the north around Simpsons Road is siltstone)

NLH A (entering the eastern perimeter of the unit near Hewitts Road and a small occurrence along the anticline ridge of Bannons Road; this geology dominates the steeper hills of management units to the east); NLH B (associated with the Templestowe Anticline which runs through the eastern section of the unit from Dunmoochin, along Hildebrand Road to Shaws Road); NLH C (generally east of the Diamond Creek with localised outcropping along the Bannons Road ridge to the west); NLH D (areas lying east of the Greensborough Syncline); NLH E (dominant geology along the St Andrews Anticline running the western boundary of the unit)

Landform/Soil Types: hill-crests, exposed hill-slopes and river spurs and cliffs/shallow, stony brown gradational; sheltered hill-slopes/yellow duplex

Silurian Sandstone/Shale

Distribution: PLH A (band broken by Quaternary volcanic incursions west of the Plenty River and east of the river north from Yarrambat Park and between Janefield and River Avenue); PLH B (centre and south sections of unit); PLH C; PLH D (band associated with the Bulleen Syncline at Diosma Road and Pauline Toner Reserves and areas to the north-west in the Woodridge estate)

YLH A (minor occurrence at Pretty Hill associated with the Bulleen Syncline); YLH B (band associated with the Bulleen Syncline west of the Mullum Mullum Creek); YLH C (separates the Devonian siltstone of the sunkland to the south-east of the Yarra Fault and the Silurian mudstone associated with the Warrandyte anticlinorium in the south-west; to the north it is replaced by the Devonian siltstone formation of the Mt Beggary Syncline; dominant geology of the Round The Bend Cooperative/Red Ironbarks); YLH D (band running north between Long Gully Road and Clintons Road in the north-west of the unit; also east of Watsons Creek in the south-east of the unit where extending onto the Round the Bend Cooperative)

NLH A (south and west sections of unit); NLH B (Barreenong Road to Mine Road); NLH C (dominant geology occurring near the boundary of the hills and volcanic plains sections of the Nillumbik Terrain in NEM and the Greensborough Syncline in the west of the Diamond Creek; a small wedge in the north-east corner of the unit extending north from the top-end of Cherry Tree Road to Church Road); NLH D (areas associated with and to the west of the Greensborough Syncline and a wedge of land associated with a syncline immediately west of the St Andrews anticline which runs north from the top of Cherry Tree Road to St Andrews); NLH E (Long Gully and areas in the south-east of the unit)

Landform/Soil Types: hill-crests, exposed hill-slopes and river spurs and cliffs/shallow stony, brown gradational; sheltered hill-slopes/yellow duplex with shallow sandy loam topsoil

Devonian Siltstone

Distribution: YLH C (extending from the Great Dividing Range in the north along the Mt Beggary syncline and terminating at Mt Graham); YLH D (broad longitudinal band running with the Mt Beggary syncline which enters the north-east section of the unit along School Road)

Landform/Soil Types: ridges, hill-crests and exposed hill-slopes/shallow stony, brown gradational; sheltered hill-slopes/yellow duplex

Devonian Volcanic Quartz-Diorite

Distribution: YLH D (small outcrop associated with minor faults in the earths crust near the Eltham–Yarra Glen Road at Watsons Creek; the quartz-diorite and quartz-feldspar plugs are the most restricted and localised geological types in NEM; quartz-diorite only occurs elsewhere at The Knobs near St Andrews)

Landform/Soil Types: volcanic plug/yellow duplex granitic sands

Devonian Volcanic Quartz-Feldspar

Distribution: YLH C (small outcrops occurring as vertical dykes associated with the Yarra Fault between Watsons Creek and Yering Gorge); YLH D (six small outcrops associated with the Yarra Fault between the Warrandyte Gorge at Bouchiers Road and Yering Gorge and one to the east of Watsons Creek, north of Henley Road; the feldspar only occurs elsewhere in NEM at Gresswell Hill, Mont Park)

Landform/Soil Types: volcanic plug/yellow duplex granitic sands

Tertiary River Alluvium

Distribution: PLH A (Plenty–Janefield and Tanunda Wetlands); PLH B (north section of the unit); PLH C (between Greenhills and St Helena Road); YLH A (old pits at Pretty Hill tip used for concrete sand production; the red-brown ironstone clay beds were mined for pottery clay; this has a high water/organic content and is plastic and subject to shrinkage; mixed in smaller proportion with fine grained inorganic clay, it is suitable for ceramics); YLH D (small extension from Kangaroo Ground Hill east of Nicholas Lane)

Landform/Soil Types: sand-plain/yellow duplex. The formation underlies the Tertiary volcanic cappings, outcropping at the edge. The origin is an ancient watercourse which outcrops also at Pretty Hill, Kangaroo Ground

Tertiary Volcanics

Distribution: PLH A (Plenty–Janefield, particularly south-east of Blue Lake and above Dry Creek); PLH B (north section of the unit); PLH C (south of Aqueduct Road and between Greenhills and St Helena Road); YLH A (Kangaroo Ground Hill, Pigeon Bank Hill and Bells Hill/northern Mt Pleasant Road); YLH D (small extension from Kangaroo Ground Hill east of Nicholas Lane)

Landform/Soil Types: hill-crest cappings/black cracking uniform clay

Quaternary Volcanics

Distribution: PLH A (west of the Plenty River)

Landform/Soil Types: stony rises and basalt escarpments/shallow red gradational; stony crests/brown uniform clay; stony plains/brown duplex: gilgai plains/grey-black duplex

Quaternary Colluvium

Distribution: PLH A (scattered occurrences; e.g. Ashley Road area); PLH B; PLH C (extensive occurrence in grassy woodland east of the Diamond Creek between Phipps Crescent and Perversi Avenue and minor occurrence along the Sawpit Gully Creek and the lower sections of smaller tributaries of the Diamond Creek); PLH D; YLH A; YLH B; YLH C (outwash slopes of Yarra Ridge); YLH D; NLH A; NLH B; NLH C (upper sections of Cherry Tree, Sawpit Gully and Watery Gully Creeks and the lower sections of smaller tributaries of the Diamond Creek); NLH D; NLH E

Landform/Soil Types: Silurian formation outwash valleys and lower hill-slopes/yellow duplex with shallow grey loam topsoil; gullies and minor creeks/yellow gradational

Quaternary Sand-Gravel Alluvium

Distribution: YLH C (Yarra Fault at Yering Backswamp)

Landform/Soil Types: Riverbanks and terraces of sand-gravel high level alluvium (Yarra)/yellow duplex

Quaternary Alluvium

Distribution: PLH A (Plenty River and tributaries); PLH B (Plenty River and tributaries); PLH C (Diamond Creek and tributaries); PLH D (Diamond Creek and tributaries); YLH A (e.g. Pretty Hill Creek); YLH B (Yarra River and tributaries); YLH C (Yarra River and tributaries); YLH D (Watsons Creek and tributaries); NLH A (Arthurs Creek and tributaries); NLH B (creeks); NLH C (Diamond, Scrubby and lower sections of Bailey Gully and Cherry Tree Creeks); NLH D (Diamond Creek and tributaries); NLH E (Long Gully Creek)

Landform/Soil Types: stream floodplains/banks and creeks on Silurian formations/yellow duplex with deep, grey loam topsoil; creeks on Quaternary volcanic formations/grey cracking uniform clay; river terraces and escarpments/sand-gravel-silt high level alluvium; wetlands/black uniform clay containing high levels of organic peat and silts

PLENTY LOWLAND HILLS (PLH)

Farmland, bushland and urban catchments of the lower Plenty River from Yallambie to Mernda and the lower Diamond Creek from Eltham to Wattle Glen.

Land-use

Past land-use: pastoral, townships, orchards, firewood and mining. Present land-use: Plenty Gorge Park, bushblock and farmlet settlement and outdoor education and recreation (e.g. horse riding and Yarrambat golf course) in the north; urban in the south and encroaching in the north.

Native vegetation cover

Fragmented in the north; highly fragmented in the south.

Key biological features

Blue-billed Duck, Barking Owl, Swift Parrot, Painted Honeyeater, Black-chinned Honeyeater, Regent Honeyeater, Yellow-tufted Honeyeater, Platypus, Large-footed Myotis (bat), Common Bent-wing Bat, Eastern Broad-nosed Bat, Flat-headed Gudgeon and Eltham Copper, Ictinus Blue and Genoveva Azure butterflies and Charming Spider-orchid, Wine-lip Spider-orchid; Blakely's Red Gum grassy woodland, box-stringybark woodland, box-ironbark woodland (Yellow Gum and Red Ironbark) and Hill Manna Gum sand-plain woodland, faunal (including butterfly) rarity, abundance and diversity, habitat rarity and diversity (Plenty Gorge) and the St Helena orchid flora; Yarrambat-Morang and Plenty-Janefield ecological reference areas and Blakely's Red Gum and Eltham Copper critical conservation areas; and strategic habitat link between the upland hills and lowland alluvial plains (the Diamond Creek).

Key areas/physical features for biota

Plenty Gorge/Plenty Gorge Park (particularly Yarrambat Ironbarks/Smugglers Gully, Plenty River, Morang Wetlands, Purvis Gully and Plenty-Janefield Yellow Gums). Diamond Creek (particularly from Eltham North to Diamond Creek), Blakely's Red Gum area east of Diamond Creek, Ironbark Road Reserve, Yandell Reserve and Eltham Copper Butterfly Reserves.

14 sites of significance: 2 national, 4 state and 8 regional for fauna and 3 very high, 5 high and 6 medium for habitat.

PLH A PLENTY GORGE

This management unit consists of two sites of national faunal significance (sites 40 and 42), one of state significance (site 41), one of regional significance (site 43) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise. The discussions in the management sections should be viewed as models for other units.

Map Reference: 7922 326271 to 7922 327353 (Plenty River).

Location/Size: Plenty River and lower reaches of tributaries and forested catchments from upstream of the Greensborough By-pass to the southern boundary of Carome. Approximately 2300 ha.

Municipality: City of Whittlesea and Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands, at the boundary of the volcanic plains. It forms a principal contact of the geology, land surface features and biota of these two biophysical areas. The basalt plains lie to the west of the river and the sedimentary hills lie to the east.

Landforms

Foothill: ridges, hill-crests, hill-slopes, valleys, gullies, river gorge, quarry wetlands and dams. Alluvial/volcanic plain: volcanic cappings, sand-plains, plain-slopes (Yarrambat–Doreen and Janefield–Blossom Park), stony rises/crests, stony plains, gilgai plains, gullies, river and floodplains, quarry wetlands and dams. There are gold mines on anticlines in the western escarpment of the river at Yarrambat and in the eastern escarpment of the river at Janefield. A north–south, upward folding anticline and smaller synclines to the east provide several geological transitional zones in the gorge. Elevation is 50–180 m.

Hydrology

The Plenty River provides the largest second order stream catchment (about 400 square kilometres) in NEM. It is a river by name rather than nature as the catchment and summer flow (15–20 ML/day) is small compared with the Yarra River (about 4000 km² and 700–800 ML/day in summer). In the Plenty Gorge, the river is perennial and contains fast-flowing rapids, cascades and rocky riffles of pebbles, cobbles and sheet rock (basalt and sedimentary origin), waterfalls and slow-moving deep water pools. The largest pool (upstream of Yarrambat falls) is 500 m long, 15 m wide and has an average depth of 4 m. The flow of the river is now about 20% of that before the Toorourrong Reservoir was built, the water diverted to Yan Yean Reservoir, the Whittlesea swamps drained and farm dams established in the catchment (see Plenty River Yan Yean unit).

Quarry wetlands. There are three quarry wetlands west of the river of high significance for waterbirds. These are the southern lake of Tanunda Wetlands at Blossom Park and the Mother-In-Law's Leap and North East Wetland of the Morang Wetlands. The latter two are on the volcanic plains and are part of the old BMG bluestone quarries. The lake at Tanunda Wetlands was formerly a sand and gravel quarry (Tertiary river alluvium). This is 4-5 ha, mainly of shallow water but contains sections over 4 m deep. Waterbird habitats include emergent herbfield (25.7) around the edges and along channels and submerged herbfield (26.1). The dead flooded eucalypts at the western end of the lake form important waterbird roosts.

The North East Wetland is 8–10 ha, mainly shallow water of 0.5–1 m average depth. It contains extensive stony-substrate shallows. The Mother-In-Law's Leap is of similar area but contains deeper water (around 6 m). Waterbird habitats at both include emergent herbfield (25.7) around the shorelines and submerged herbfield (26.1). A recently constructed 5 ha shallow freshwater marsh (Wilton Vale Marsh) lies to the north of the Mother-In-Law's Leap. Waterbird habitats include freshwater meadow (25.1) around the shoreline, inlets and islands and submerged herbfield (26.1).

Rainfall: 640–680 mm.

Site 40 Yarrambat–Morang Wetlands

- Map Reference:** 7922 330325 to 7922 327353 (Plenty River); 7922 340344 (upper end of Yarrambat pool); 7922 342339 (Yarrambat waterfall); 7922 333333 (Yarrambat Ironbarks /Eagle Point rapids); 7922 326337 (Mother-In-Law’s Leap); 7922 332337 (North East Wetland); 7922 325339 (Wilton Vale Marsh). One minute lat/long grids include 37° 37' x 145° 05' to 07'.
- Location/Size:** Plenty River and local catchment from upstream of Smugglers Gully to the southern boundary of Carome. Approximately 300 ha.
- Municipality:** City of Whittlesea (Morang Wetlands) and Shire of Nillumbik (Yarrambat).
- Land Tenure/Use:** Public: Plenty Gorge Park (Melbourne Parks & Waterways). Private: bushland near river zoned Conservation and Proposed Public Open Space; land backing the Conservation Zone in Shire of Nillumbik, is proposed urban development.
- Landforms:** Foothill and alluvial and volcanic plain (see PLH A). Elevation is 130–180 m.

Natural Heritage Values

Landscape. The site has high visual drama and diversity of landform and geological types. It contains some of the highest natural heritage and landscape values in NEM including the most intact river terrain and most extensive and diverse wetland system in NEM. With the constraints placed on the Plenty–Janefield and Kurrag Road sites by urban development to the west, the volcanic plains landscape at Morang Wetlands will be the most extensive remaining in the gorge. Along with these sites, the Yarrambat–Morang Wetlands forms the most intact contact point in NEM between three distinct biotas: volcanic plains (grassy woodland); alluvial plains (floodplain riparian woodland); and lowland hills (box–stringybark and box–ironbark woodlands). Most of the woodland communities contain overlapping features of volcanic plains grassland and sedimentary foothill forest.

The Yarrambat–Morang Wetlands site is substantially contained within Plenty Gorge Park, the largest biological reserve in the Plenty Lowland Hills. The site will not be hemmed in by development as severely as other sites in the gorge as it is buffered by Yarrambat Park and lower density farmland. It has less conflicting internal land ownership and land-use problems. As a result, it receives a higher level of protection and management input.

Scientific and Educational Values

Scientific reference–Regent Honeyeater and Red Ironbark research. Nectarfauna census plot in the Yarrambat Red Ironbarks. Regent Honeyeater populations and Red Ironbark flowering and nectar production were monitored between 1977 and 1991 at the Yarrambat Ironbarks census study and reference site (see Regional Habitat Link Strategy). The census plot forms the principal habitat of the endangered Regent Honeyeater in GM. These studies determined that the failing flowering and nectar production of Red Ironbarks resulting from land clearing and rising populations of fragmentation birds and leaf defoliating insects may be a major reason for the decline of the Regent Honeyeater. An Ecological Reference Area is proposed for the river and adjoining bushland from Smugglers Gully to Clements Gully and the Morang Wetlands (see planning recommendations).

Electrofishing sites and instream reference points in the Plenty River at Wilton Vale Farm upstream of Yarrambat pool and at Eagle Point rapids.

Rehabilitation and management. Extensive remodelling, rehabilitation and management works are being conducted at the Morang Wetlands (see conservation measures).

Public interpretation. There is high potential for education about wetland fauna and faunal habitat values at the Morang Wetlands. Access will require strict controls. This area and the adjacent gorge and ironbarks sections at Yarrambat offer a unique combination of fauna and faunal habitats in GM.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Manna Gum (riverbank) floodplain riparian woodland (16.4); Muttonwood riparian scrub (18.1)

Relatively intact and extensive stands: Red Ironbark–Yellow Gum box–ironbark woodland (12.2; Yarrambat ironbarks); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2; Rapaport cliffs); Golden Wattle cliff/escarpment shrubland (20.4; Yarrambat ironbarks); Black Wattle–Tree Violet cliff/escarpment shrubland (20.5; Wallaby Rocks); Rush Sedge–Common Spike-sedge seasonal wetland (25.1; Wilton Vale Marsh); Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7; Morang Wetlands); Blunt Pondweed permanent wetland (26.1; Wilton Vale Marsh)

Vulnerable species: Spotted Duckweed (Wilton Vale Marsh)

Rare species: River Swamp Wallaby-grass, Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Yarrambat–Morang Ecological Reference Area and Strategic Habitat Link. Riparian reference stands; Yarrambat ironbarks critical honeyeater habitat and ‘goldfields’ flora; Morang Wetlands habitat extent and diversity

FAUNAL SIGNIFICANCE: Site 40 Yarrambat

Assessment: National—Category 1 (B, C, D, F); State (B, C, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

40^a: 37° 37' x 145° 05'; Plenty Gorge Park—west section of Wilton Vale

40^b: 37° 37' x 145° 06'; Plenty Gorge Park ERA—Yarrambat Ironbarks/Morang Wetlands

40^c: 37° 37' x 145° 07'; Plenty Gorge Park—Yarrambat Park

A. Cited Zoological Significance

State. Beardsell (1989); Biosis (1991)

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

National. 40^b: Regent Honeyeater: repeated sightings/successful breeding

b. Vulnerable fauna

State. 40^b: Swift Parrot: two sightings of 2 to 6 birds

c. Rare fauna

State. 40^b: 11 species. Lewin's Rail, Painted Snipe, Little Bittern, Freckled Duck, Blue-billed Duck (breeding), Barking Owl (breeding), Powerful Owl, Brush-tailed Phascogale (breeding), Common Dunnart (breeding), Large-footed Myotis, Eastern Broad-nosed Bat (breeding) and Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

State. 40^b: 30 species (172 individuals) in a 60-minute census at Wilton Vale Marsh on 1 January 1996

d. Breeding waterfowl

State. 40^b: 13 species at Morang Wetlands on 12 December 1995

e. Honeyeaters

National. 40^b: 13 species in the June 1988 nectarfauna census at Yarrambat Ironbarks; highest diversity recorded in GM

f. Breeding migratory insectivores

State. 40^b: 12 species including the Rainbow Bee-eater, Leaden Flycatcher, Satin Flycatcher and White-throated Gerygone between Eagle Point rapids and middle Wilton Vale Creek on 3 December 1986

g. Breeding parrots

Regional. 40^b: 7 species including the Little Corella, Long-billed Corella and Little Lorikeet between Eagle Point rapids and middle Wilton Vale Creek on 3 December 1986

h. Bats

Regional. 40^b: 6 species trapped between 12 and 14 November 1988 at the Eagle Point rapids

i. Arboreal mammals

Regional. 40^b: 4 species including the Sugar Glider and Brush-tailed Phascogale trapped between 16 and 18 February 1987 at Yarrambat ironbarks

j. Ground mammals

Regional. 40^b: 5 species including the Platypus and Water Rat on 16 November 1987 at the Ironbarks/Eagle Point rapids

k. Frogs

Regional. 40^b: 7 species at Yarrambat Park on 3 December 1986 and 9 February 1987 including the Striped Marsh Frog; 6 species at Morang Wetlands on 20 April 1987 including the Common Spadefoot Toad and Bibron's Toadlet

l. Reptiles

State. 40^b: 17 species including the Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, White's Skink, Blotched Blue-tongued Lizard, Delicate Skink, Weasel Skink, Bougainville's Skink, Tussock Skink, Red-bellied Black Snake and Lowland Copperhead in a 3-hour search from Yarrambat ironbarks/Eagle Point, along Wilton Vale Creek to Morang Wetlands on 13 November 1988

m. Freshwater fish

Regional. 40^b: Short-finned Eel, Common Galaxias and Flat-headed Gudgeon electrofished from between Eagle Point rapids and the top end of the falls pool on 15 December 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 40^b: over 220 native species

b. Native birds

National. 40^b: over 160 species

c. Native mammals

State. 40^b: 25 species

d. Herpetofauna

State. 40^b: 32 species

e. Freshwater fish

Regional. 40^b: Short-finned Eel, Common Galaxias, Freshwater Blackfish and Flat-headed Gudgeon

f. Butterflies

Regional. 40^b: 24 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 40^b: 86 species. The highest diversity in GM

b. Regionally endangered fauna (R1 species)

State. 40^b: 13 species. **Birds:** Painted Snipe, Glossy Ibis, Intermediate Egret, Freckled Duck, Cockatiel, Dollarbird, Red-capped Robin, White-bellied Cuckoo-shrike, Tawny-crowned Honeyeater, Black Honeyeater, Regent Honeyeater, Little Friarbird. **Mammals:** Eastern Broad-nosed Bat

Regional. 40^c: 1 species. **Butterflies:** Ictinus Blue

c. Regionally vulnerable fauna (R2 species)

State. 40^b: 31 species. **Birds:** Crested Pigeon, Lewin's Rail, Spotless Crake, Whiskered Tern, Black-winged Stilt, Red-necked Stint, Little Egret, Little Bittern, Black-tailed Native-hen, Spotted Harrier, Black Kite, Barking Owl, Blue-winged Parrot, Azure Kingfisher, Black-eared Cuckoo, Red-capped Robin, Hooded Robin, White-throated Gerygone, Southern Whiteface, Brown Treecreeper, Black-chinned Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater, Diamond Firetail. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Eastern Freetail Bat, Large-footed Myotis. **Frogs:** Peron's Tree Frog. **Fish:** Freshwater Blackfish, Flat-headed Gudgeon

d. Regionally rare fauna (R3 species)

State. 40^b: 21 species. **Birds:** Australian Spotted Crake, Red-kneed Dotterel, Australasian Shoveler, Pink-eared Duck, Hardhead, Blue-billed Duck, Musk Duck, Collared Sparrowhawk, Little Corella, Fork-tailed Swift, Pink Robin, Spotted Quail-thrush, Masked Woodswallow, White-browed Woodswallow. **Mammals:** Feathertail Glider, Grey-headed Flying-fox, Gould's Long-eared Bat. **Reptiles:** Murray River Tortoise, Marbled Gecko, Eastern Small-eyed Snake. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

State. 40^b: 20 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Swamp Harrier, Whistling Kite, Peregrine Falcon, Swift Parrot, Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, Bassian Thrush, White-winged Triller, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink, Red-bellied Black Snake. **Frogs:** Bibron's Toadlet. **Butterflies:** Small Copper

f. Regionally restricted fauna (R5 species)

Regional. 40^b: 36 species. **Birds:** Painted Button-quail, Pied Cormorant, Australian Pelican, Banded Lapwing, Royal Spoonbill, Great Egret, Cattle Egret, Nankeen Night Heron, Australian Shelduck, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brush Cuckoo, Rose Robin, Olive Whistler, Brown Songlark, Red-browed Treecreeper, Spiny-cheeked Honeyeater, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, Delicate Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Phigalia Skipper, Meadow Argus, Chequered Blue, Dark Purple Azure

g. Nesting birds of prey/parrots

Regional. 40^b: Wedge-tailed Eagle, Whistling Kite, Collared Sparrowhawk and Peregrine Falcon (old Wedge-tailed Eagle eerie at Eagle Point): each in stick-nests near the river. Little Corella, Long-billed Corella and Little Lorikeet: each in Manna Gum hollows along the river and major gullies. Swamp Harrier: potential to breed at Morang Wetlands.

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

State. 40^b: over 30 Latham's Snipe in a 60-minute census at Wilton Vale Marsh on 1 January 1996

b. Rare or threatened fauna

Regional. 40^b: 6 Swift Parrots at Eagle Point on 8 September 1986; 10 Blue-billed Ducks at Mother-In-Law's Leap on 23 February 1988; 6-9 birds recorded on frequent occasions

c. Waterfowl

Regional. 40^b: 183 of 14 species at Mother-In-Law's Leap/North East Wetland on 15 March 1991; 105 of 16 species in a 60-minute census at Wilton Vale Marsh on 1 January 1996

e. Honeyeaters

National. 40^b: over 1000 (excluding wattlebirds and miners) in the 2 ha Red Ironbark census plot at Yarrambat ironbarks in June 1988

f. Frogs

Regional. 40^b: over 50 Growling Grass Frogs, Common Bullfrogs and Verreaux's Tree Frogs at Morang Wetlands in November 1987

g. Rare/restricted colonial fauna

Regional. 40^b: 300 Australian White and Straw-necked Ibis roosting at Yarrambat pool during winter 1990; breeding colony of 5 Nankeen Night Herons at the upstream end of Yarrambat pool on 3 December 1986; roosting colony of 68 Cattle Egrets at Wilton Vale Marsh on 15 October 1996

l. Regionally vulnerable fauna (R2 species)

Regional. 40^b: 10 Fuscous Honeyeaters at Yarrambat ironbarks in June 1986 census; 10 Black-winged Stilts at Wilton Vale Marsh on 3 November 1995 and 15 October 1996; 6 Whiskered Terns and over 10 Peron's Tree Frogs at Wilton Vale Marsh on 1 January 1996; 5 Flat-headed Gudgeon at Wilton Vale rapids on 15 December 1988

m. Regionally rare fauna (R3 species)

Regional. 40^b: 12 Hardheads at Mother-In-Law's Leap/North East Wetland on 15 March 1991; 7 Hardheads at Wilton Vale Marsh on 1 January 1996; 6–8 Grey-headed Flying-fox at Yarrambat ironbarks on 4 June 1996, 50 Eastern Small-eyed Snakes under debris in the basalt margin of a small pond at Morang Wetlands on 15 September 1996

o. Regionally restricted fauna (R5 species)

Regional. 40^b: qualifying populations recorded of Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, White-winged Chough, Delicate Skink, Tussock Skink and Striped Marsh Frog

Outlook

The Yarrambat–Morang Wetlands site has the highest faunal significance ranking in NEM (next highest is Craigieburn Grassland with National Category 2). It supports a lower density and richness of woodland and grassland species (e.g. honeyeaters and Rainbow Bee-eaters) now than in the 1970s but waterbird values have increased with the development of Morang Wetlands. It retains National faunal significance because the threatened species and habitats that make it such have become rarer throughout their range. By definition, when a site such as Yarrambat is placed under sound management, it becomes increasingly more significant over time as the threatened values decline universally elsewhere. This underlines the importance of identifying and managing these sites. Several of the woodland, grassland and instream species are under threat of local extinction. Specific conservation management and habitat enhancement must be addressed for these species.

FAUNA

Rare or Threatened Fauna

Ba 40^b: Regent Honeyeater. This species was frequently observed at Yarrambat ironbarks between 1977 and 1988 but infrequently since then. This alarming trend has occurred throughout the range of the honeyeater. It is thought that the total population now numbers fewer than 100 birds. The habitat most frequently utilised at Yarrambat is Red Ironbark–Yellow Gum box–ironbark woodland (12.2). Long-leaf Box–Manna Gum escarpment woodland (13.1), Red Box escarpment woodland (13.3) and Manna Gum floodplain riparian woodland (16.4) are occasionally visited. Regent Honeyeaters predominantly take nectar but supplement their diet with insects. They were observed in all four seasons of 1988 and successfully bred in October 1978 and November 1988. They were most frequently seen in the canopy of the largest and most vigorous trees, in prolific flowering years (e.g. 1977, 1983 and 1988). In these years, successive flowering of Manna Gum, Red Ironbark, Yellow Gum, Red Box and Yellow Box retained them at Yarrambat for up to nine months (February to November).

They were observed each year at Yarrambat from 1974- to 1979. Thirty birds appeared in late summer–autumn 1977, remaining until mid-spring for a prolific flowering season of Red Ironbark and Yellow Gum. By the late 1980s numbers had declined and years without sightings were becoming more frequent. Only single pairs

have been observed since 1981 and these only in 1983 and 1988, each a prolific flowering year of Red Ironbarks. Single birds were seen in 1986 and 1989.

Regent Honeyeaters are seasonally mobile. In their annual feeding cycle they depend on a reliable series of nectar flows from suitable tree species in extensive stands of mature and healthy box–ironbark woodland and riparian woodland/forest. Few of these stands remain. They avoid fragmented or thinned stands where large numbers of Noisy Miners and Red Wattlebirds occur. The decline of the Regent Honeyeater has accompanied a noticeable decline in the vigour of Red Ironbarks and Yellow Box (both critical food resource trees) due to the long term effect of dieback related stress, caused by stand thinning and fragmentation (see the Kangaroo Ground–St Andrews Road Red Ironbarks site).

- Bb* **40^b: Swift Parrot.** Not often recorded at Yarrambat. Six birds were seen feeding on psyllids in a Yellow Box (Long-leaf Box–Manna Gum escarpment woodland; 13.1) at Eagle Point on 8 September 1986 and two birds were observed in flowering Manna Gums (floodplain riparian woodland; 16.4) adjacent to Yarrambat ironbarks on 28 March 1988.
- Bb* **40^c: Ictinus Blue butterfly.** A small colony of the vulnerable Ictinus Blue was located on 19 March 1993 in Yellow Box–Red Stringybark box–stringybark woodland (11.2) at Yarrambat Park. The butterfly appeared to be colonising a stand of regenerating Black Wattles on an open spur above the river. There was a substantial Meat Ant colony present. This species attends the butterfly larvae. The wattles had regenerated since the removal of livestock for the establishment of the golf course in about 1980. In 1995, SEC contractors removed all of the Black Wattles in the vicinity of the butterfly colony. The power line is high overhead at this point and removal of the wattles appears to have been unnecessary. An adult male Ictinus Blue was seen at the locality in February 1996, but no breeding colony could be located. It is urgent that Black Wattles be replanted in the vicinity of the Meat Ant nests.
- Bc* **40^b: High diversity of rare species.** Twelve rare, potentially threatened, insufficiently known or indeterminate species were recorded at Yarrambat. Several of these (Brush-tailed Phascogale, Common Dunnart and Large-footed Myotis) are close to their nearest known approach to the Melbourne CBD.
- Bc* **40^b: Lewin’s Rail, Painted Snipe and Little Bittern.** A Lewin’s Rail had been seen in reed beds along the river downstream of Yarrambat falls in the 1982 drought (Manna Gum floodplain riparian woodland; 16.4). Another was observed in Cumbungi beds along upper Wilton Vale Creek on 20 October 1991 (River Red Gum (plains) drainage line woodland; 30.1). A Painted Snipe had been observed at Morang Wetlands in the 1977 drought. A single bird flushed with Latham’s Snipe from Rush Sedge–Common Spike-sedge seasonal wetland (25.1) along the shoreline of Wilton Vale Marsh during the 1 January 1996 bird census. This is only the second observation in NEM over the last decade. The other was at Towts Swamp (site 37) on 4 October 1988. Rare and sporadic spring-summer visitor from northern Australia. A Little Bittern was observed on 20 October 1991 in the same reed beds along the river as where the Lewin’s Rail had been seen. One had been previously seen in the 1982 drought at the Tall Spike-sedge dominated dam (seasonal wetland 25.7) at the north-east corner of Plenty Road and Wilton Vale Road.
- Bc* **40^b: Barking Owl and Powerful Owl at Yarrambat ironbarks.** Both were recorded in Red Ironbark–Yellow Gum box–ironbark woodland (12.2). The Barking Owl was resident and likely breeding in 1986/87 and 1991/92. Juvenile Powerful Owls visit during autumn and winter. One was seen from April to August 1996 (Mark Tscharke pers. comm.). It roosted in a large Red Ironbark. One had been previously seen in March 1991.
- Bc* **40^b: Freckled Duck.** Single bird observed in company with 150–200 other waterfowl amongst Blunt Pondweed permanent wetland (26.1) at North East Wetland over 20/21 February 1997. Also seen on the Gordons Road tip retardation ponds to the south. During dry summers such as 1996/97, local waterfowl and occasional vagrants such as Freckled Duck from the inland seek refuge on the permanent water of Morang Wetlands (see site 12).
- Bc* **40^b: Blue-billed Duck.** Recorded consistently if not resident over the last 8 years, in numbers of 5-10 birds at Morang Wetlands. They are seen mainly on the deep, open water of Mother-In-Law’s Leap in the breeding season (where they construct platform nests of trampled Cumbungi over the water; seasonal wetland 25.7). In summer they are more frequently seen on the productive Wilton Vale Marsh (however a pair appeared to nest

there in November 1996; seasonal wetland 25.1). They return to the permanent Mother-In-Law's Leap/North East Wetland as the marsh dries in late summer/autumn.

- Bc* **40^b: Brush-tailed Phascogale and Common Dunnart.** Both species were trapped at Yarrambat ironbarks on 18 February 1988 in Red Ironbark–Yellow Gum box–ironbark woodland (12.2). A male Brush-tailed Phascogale was taken in a tree trap placed 6 m up a Yellow Gum. A female Common Dunnart was taken on the ground in an Elliott trap.
- Bc* **40^b: Large-footed Myotis.** A pair of Large-footed Myotis was observed on 24 January 1991 courting for insect prey over the upstream section of Yarrambat pool (Manna Gum floodplain riparian woodland; 16.4). They had been observed in the late 1970s and early 1980s on occasions in the lower section of Yarrambat pool and at the pools downstream of Yarrambat falls. The species may roost in the numerous crevices and small caves and possibly the horizontal drives of mine shafts in the western basalt escarpment of the gorge.
- Bc* **40^b: Eastern Broad-nosed Bat.** The species occurs in foothill and coastal riparian woodland/forest of eastern Victoria. The western range limit in southern Victoria is the Plenty Gorge and Gresswell Forest. Two were trapped on 24 January 1991 along the river north of Wilton Vale farm. The trapsite was an area of riffles separating rapids upstream (Muttonwood riparian scrub; 18.1) from the Yarrambat pool downstream (Manna Gum floodplain riparian woodland; 16.4). One was a lactating female, likely breeding locally.
- Bc* **40^b: Freshwater Blackfish.** One was taken by a local angler in the pool upstream of Eagle Point rapids in 1992. This is the only known record of blackfish from the Plenty Gorge for over a decade. They were more frequent in the 1970s but there has been a noticeable deterioration in water quality since that time. They may inhabit similar pools in downstream sections of river between Kurrak Road and Gordons Road. The blackfish was not detected in the intensive netting survey of Yarrambat pool in January 1989. Deeper pools in the gorge are heavily silted and nutrient enriched and the water appears lacking in oxygen and plant and animal life. Declining water and habitat quality has apparently eliminated the species from the Plenty–Janefield site. The adequate substrate habitat (e.g. logs) and lower rates of riparian weed cover and bank disturbance has enabled the species to persist at Yarrambat. Unless water quality can improve, there would appear little chance of blackfish populations surviving in the long-term.

Critical Assemblages or Populations

Cb 40^b: High diversity of waterbirds—Wilton Vale Marsh census, January and November 1996. Thirty waterbird species were recorded at Wilton Vale Marsh in a 60-minute census on 1 January 1996. There were 105 individuals of 14 species of waterfowl. Notable waterbirds included the Whiskered Tern (6), Latham's Snipe (30), Painted Snipe (1), Black-winged Stilt (pair breeding), Intermediate Egret (3), Red-kneed Dotterel (2), Yellow-billed Spoonbill (2), Blue-billed Duck (2), Hardhead (7), Australian Shelduck (1), Australian Shoveler (4), Pink-eared Duck (1), Musk Duck (1) and Swamp Harrier (1). The Pink-eared Duck remained until July 1996. This species is very rare in the lowland hills.

Twenty four waterbird species including four Red-necked Stints were recorded at Wilton Vale Marsh in a 60-minute census on 8 November 1996. There were 101 individuals of 12 species of waterfowl present. Twelve species of waterbirds were breeding, including the Dusky Moorhen (2 pair), Purple Swamphen (2 pair), Eurasian Coot (5 pair), Australasian Grebe (7 pair), Red-kneed Dotterel (2 pair), Masked Lapwing (4 pair), Black-fronted Dotterel (7 pair), Black-winged Stilt (5 pair), Australian Wood Duck (1 pair), Pacific Black Duck (at least 2 pair), Chestnut Teal (1 pair) and Australasian Shoveler (2 pair). Eight Chestnut Teal were recorded in the count. On the evening of 12 November 1996, about 12 additional Chestnut Teal arrived on dusk along with over 20 Australian Wood Duck; 17 Cattle Egrets also arrived to roost in a River Red Gum. Chestnut Teal were locally rare before the construction of Wilton Vale Marsh.

Fifty species of waterbirds were recorded at the Morang Wetlands between 1991 and 1996, 22 of which were breeding. The combination of tall, dense cover amongst the Cumbungi and bare water fringes at the Mother-In-Law's Leap is utilised by crakes. This wetland and Wilton Vale Marsh contain extensive submerged meadows of Fennel Pondweed, Blunt Pondweed and Red Milfoil which attract waterfowl such as the Black Swan, Grey and Chestnut Teal and Blue-billed Duck. These upend in shallow water, stripping shoots and seeds from substrate vegetation. The Australasian Shoveler, an invertebrate feeder, is also frequently observed. As the North East Wetland develops it will become more important for waterbirds. The extensive shallows are already utilised by many waders and waterfowl. It has emergent rocks which provide bird roosts.

Cd 40^b: High diversity of breeding waterfowl—Morang Wetlands, December 1995. Thirteen species were recorded breeding at Morang Wetlands on 12 December 1995. These included the Hoary-headed Grebe (North East Wetland), Blue-billed Duck, Hardhead (Mother-In-Law's Leap.), Black Swan, Chestnut Teal and Australasian Shoveler (Wilton Vale Marsh). This was the first breeding record of the Chestnut Teal at Morang Wetlands.

Ce/Fe 40^b: Red Ironbark nectarfauna census: Yarrambat Ironbarks. Annual 2 ha/20-minute bird counts were conducted in Red Ironbark–Yellow Gum box–ironbark woodland (12.2) between 1020 and 1040 hours during a sunny and calm period in June from 1977 to 1992. The census at Yarrambat followed on the same day as the census at the Haleys Gully Road Ironbarks. Peak flowering years when over 30% of the Red Ironbarks flowered heavily included 1977 (census day: 12 June), 1983 (census day: 27 June) and 1988 (census day: 12 June). These years respectively contained 134, 95 and 70 heavily flowering Red Ironbarks. In all other years, including each of 1989 to 1992, less than 10% of the trees flowered.

The census plot is on the eastern escarpment of the Plenty River, west of the end of Ashley Road. It was incorporated into the Plenty Gorge Park in late 1992. Red Box escarpment woodland (13.3) occurs along the eastern escarpment downstream. Yellow Box–Red Stringybark box–stringybark woodland (11.2) and Golden Wattle cliff/escarpment shrubland (20.4) occupy the eastern escarpment of Yarrambat Park upstream. The Plenty River runs along the western edge of the stand. The river and lower terraces contain Manna Gum floodplain riparian woodland (16.4/16.5) and Muttonwood riparian scrub (18.1). Long-leaf Box–Manna Gum escarpment woodland (13.1) occurs on the western escarpment of the river.

Yarrambat Ironbarks: Results

1977 bird summary: 15 species and over 2400 individuals (estimated) including the White-naped Honeyeater (1400 estimated), Black-chinned Honeyeater (20), Brown-headed Honeyeater (700 estimated), Eastern Spinebill (6), Tawny-crowned Honeyeater (2), Regent Honeyeater (10), Yellow-faced Honeyeater (70), White-eared

Honeyeater (3), Yellow-tufted Honeyeater (10), Fuscous Honeyeater (40), White-plumed Honeyeater (2), Crescent Honeyeater (7), New Holland Honeyeater (15), Red Wattlebird (70) and Little Friarbird (10).

1983 bird summary: 15 species and over 1600 individuals (estimated) including the White-naped Honeyeater (1000 estimated), Black-chinned Honeyeater (16), Brown-headed Honeyeater (400 estimated), Eastern Spinebill (3), Tawny-crowned Honeyeater (1), Regent Honeyeater (2), Yellow-faced Honeyeater (50), White-eared Honeyeater (2), Yellow-tufted Honeyeater (6), Fuscous Honeyeater (30), White-plumed Honeyeater (15), Crescent Honeyeater (4), New Holland Honeyeater (25), Red Wattlebird (80) and Bell Miner (8).

1988 bird summary: 15 species and over 1200 (estimated) individuals including the White-naped Honeyeater (700; estimated), Black-chinned Honeyeater (2), Brown-headed Honeyeater (300; estimated), Eastern Spinebill (4), Tawny-crowned Honeyeater (1), Regent Honeyeater (2), Yellow-faced Honeyeater (20), White-eared Honeyeater (1), Yellow-tufted Honeyeater (2), Fuscous Honeyeater (10), White-plumed Honeyeater (20), Crescent Honeyeater (1) New Holland Honeyeater (40), Red Wattlebird (100) and Bell Miner (10).

Yarrambat Ironbarks: Discussion. The plot supports 180 Red Ironbarks and 220 Yellow Gums with DBH exceeding 30 cm and is contained in an old growth stand of about 5 ha of box–ironbark woodland. The ironbark stand formerly extended over about 10 ha but became fragmented when the eastern section was cleared (possibly late 1940s) and the southern section connecting Smugglers Gully was cleared in about 1962. Further stand fragmentation occurred in the south-eastern corner adjacent to Smugglers Gully in 1978 with the clearing of about 1 ha of Red Stringybark herb-rich foothill forest (6.1). Cleared land (now under revegetation) fronts the stand on these sides. The census plot is in the centre of the 5 ha stand and has remained intact throughout the survey period. It is still the largest and most intact stand of Red Ironbark–Yellow Gum box–ironbark woodland in NEM.

Twenty-minute/2 ha bird counts were conducted and nectar production, flowering tree and blossom rates were measured each year (see Regional Habitat Link Strategy and Haleys Gully Road Red Ironbarks site). Over the 16-year survey, the ratio of heavy flowering to non-flowering trees declined by almost 50%. In all other years, including each of 1989 to 1992, less than 10% of the trees flowered and the total honeyeater counts were about 10% of that of the previous heavy flowering year. An alarming trend is that in the years 1985 to 1992 (except for 1988), few trees flowered heavily and few honeyeaters were present. This trend continued from 1993 to 1996. The cycle of heavy flowering years over the 16-year period study broadened from five to six years to eight to ten years. Poor flowering years in the late 1970s still provided about half the numbers of birds (about 1200) of heavy flowering years. In other words, in the late 1970s large populations of honeyeaters visited each year, and massive populations visited every five to six years.

Full daylight counts and the nectar secretion rates were recorded at 30-minute intervals in the Red Ironbarks in mid June 1977. Annual 20-minute counts of birds and measurements of nectar secretion were conducted between 1020 and 1040 hours during a sunny and calm period each mid June from 1977 to 1992. It was ascertained that the rate of nectar secretion and blossom production of the Red Ironbark reference tree fell by 20% (see Regional Habitat Link Strategy and the Haleys Gully Road Red Ironbarks site). There appears to be a constant ratio from year to year between the number of trees that flower, the number of flowers on each tree and the rate of nectar secretion of individual flowers. In heavy flowering years, more trees flower and the rate of flower and nectar production on these trees is higher. In the intervening years, all are lower. In the only recent heavy flowering year (1988) the total nectarfauna population was about the same as those in the poor flowering years of the late 1970s. Over the 16 years, the combination of declining rates of flowering trees, flower production and nectar secretion, has contributed to a steady two-fold reduction in the visitation rates of honeyeaters in heavy flowering years. Few honeyeaters now visit in poor flowering years. This decline is also attributable to the failing flowering/nectar production of stands elsewhere in the district and throughout Victoria (see Regional Habitat Link Strategy).

The decline was largely of the forest-dependent Melithreptids (White-naped, Black-chinned and Brown-headed Honeyeaters) and Lichenostomids (e.g. Fuscous and Yellow-tufted Honeyeaters) and the forest-dependent Regent Honeyeater and Little Friarbird. In heavy flowering years many of these birds probably come from the ironbark woodlands of northern Victoria, which generally flower in late winter. Over the last decade they have almost stopped coming (see Regional Habitat Link Strategy). Two of the dominant species of recent years (Bell Miner

and White-plumed Honeyeater) were rare or absent in 1977. The White-plumed Honeyeater is the only Lichenostomid to have increased. It is an open woodland species.

In 1977, 3% of the nectivores present were species that occupy forest edges (predominantly the Red Wattlebird). With the establishment of the Bell Miner and White-plumed Honeyeater in the 1980s, this group total had increased to over 10% in 1988. They comprised 50% of the nectivores over the four consecutive poor flowering years of 1989 to 1992 (e.g. 60 of 119 birds in 1991). All of the forest-dependent honeyeaters have decreased in numbers, some appreciably (e.g. Regent Honeyeater, Yellow-tufted Honeyeater, Fuscous Honeyeater and Black-chinned Honeyeater) while the Little Friarbird no longer visits the ironbarks during winter.

Nectar-feeding behaviour studies conducted during the 16-year counts at Yarrambat revealed that the congeneric (same genus) groups of honeyeaters (i.e. Melithreptids: White-naped, Brown-headed and Black-chinned Honeyeaters; Lichenostomids: Fuscous, Yellow-tufted, White-plumed, Yellow-faced and White-eared Honeyeaters; and Phylidonyrids: Crescent, New Holland and Tawny-crowned Honeyeaters) avoided direct competition for nectar by altering their daily timing, pattern (e.g. flocking at particular foraging levels) and type of feeding activity (e.g. becoming mobile and switching from nectivory to insectivory).

Nectivore summary for the Yarrambat Ironbarks bird census plot. The stand of Red Ironbark–Yellow Gum box–ironbark woodland on the Plenty River at Yarrambat is collectively called the Yarrambat ironbarks. In 1988, during the flowering season of Red Ironbark and Yellow Gum from late autumn to early spring, the stand contained nine forest-dependent species of honeyeaters including one that is endangered and three regionally vulnerable inland species. The flowering of Red Ironbark dominates the first half of the period and that of Yellow Gum dominates the second. In prolific flowering years for both eucalypt species from 2000 to 5000 birds are present. The stand at these times supports the highest density and diversity of nectivores (nectar feeding birds) seen in GM. The following is a detailed account of all honeyeater species recorded at the Yarrambat ironbarks.

Melithreptids: White-naped Honeyeater. They were by far the most common nectivore, particularly in heavy flowering years. Over 3000 were present in the 5 ha stand during the June 1977 census and over 1500 were present in 1988. Numbers that visited in recent poor flowering years comprised about 10% of the numbers that visited in similar years in the late 1970s. White-naped Honeyeaters are present throughout the year and breed in the local gullies (particularly in the canopies of dense stands of Manna Gums and Yellow Box) but none of the population appear sedentary. An autumn-winter influx from the ranges and possibly some long distance dispersal of birds from outside NEM is associated with the flowering of the Red Ironbarks. They are the most locally mobile Melithreptid while feeding and are the most dependent on nectar.

White-naped Honeyeaters take nectar from the mid-tree and canopy levels of flowering eucalypts and less frequently from shrubs. They also glean small foliage invertebrates, particularly psyllids and their honeydew exudates from the outer foliage of eucalypts and manna exudates caused by insect or vertebrate damage on leaves and branches of eucalypts and wattles. They are important biological control agents of eucalyptus leaf defoliators (e.g. psyllids).

At Yarrambat, they predominantly feed in Red Ironbark during the mid-morning nectar production peak. In the late afternoon they enter Yellow Gums in prolific flowering years when nectar has accumulated from the daily production to high levels. On calm, mild days in prolific years they re-enter the Red Ironbarks in the late afternoon for surplus nectar in flowers missed from the morning feeding foray. Insect gleaning activity in Red Ironbarks and Yellow Gums also peaks in the late afternoon. This is probably the most efficient feeding period for the honeyeater. During the middle part of the day, particularly when windy, nectar is not readily available from Red Ironbarks nor has it accumulated in sufficiently large quantities in Yellow Gums. At this time of day they become mobile and range locally in search of other nectar sources and foliage insects which are more randomly distributed.

Brown-headed Honeyeater. Small numbers breed locally in herb-rich foothill forest and box–stringybark woodland (drier slopes than the White-naped Honeyeater) in spring. These birds are possibly resident throughout the year. Large influxes into the flowering Red Ironbarks occur during autumn-winter from outside the district, possibly the ranges. Their pattern of nectar feeding behaviour is similar to the White-naped Honeyeater, but their diet contains a higher proportion of invertebrates. When in mixed nectar-feeding flocks, they tend to confine

themselves to denser inner foliage and branches of the middle and upper layers of trees while White-naped Honeyeaters utilise all strata, particularly the outer foliage where psyllids are present.

Brown-headed Honeyeaters were the second most common nectivore during both the morning nectar peak of Red Ironbarks and late afternoon feeding forays in Yellow Gums/Red Ironbarks. In the middle of the day they were virtually absent from the census plot. They spend this time roaming locally with White-naped Honeyeaters, foraging for insects. One of their major insect feeding activities is searching the loose hanging bark of branches of gum-barked eucalypts.

Black-chinned Honeyeater. They are seen in small numbers between late autumn and early spring in years of prolific nectar/flowering Red Ironbarks, probably arising from inland Victoria. In the census plot their main feeding activity is gleaning invertebrates from leaves and branches. Nectar is taken from Red Ironbark during the morning peak and less frequently from Yellow Gum/Red Ironbark during the late afternoon. They become locally mobile during the middle of the day and engage in gleaning insects from foliage (predominantly psyllids) and blossoms. Populations at Yarrambat have declined dramatically since 1983 and the period between years of sightings has broadened.

Lichenostomids: Fuscous Honeyeater. They visit Yarrambat at higher densities than elsewhere in NEM and appear at intervals of five to eight years to coincide with prolific flowering Red Ironbark. About once in ten years, after inland droughts (e.g. 1977 and 1983) irruptions of 100 to 200 birds occurred. Their numbers have declined over the last decade. While feeding they utilise the mid-tree and canopy layers and overlap the niches of the White-naped and Brown-headed Honeyeaters. They are mostly nectivorous when nectar is abundant. They visited the census plot only during the morning nectar flow peak of Red Ironbark and the late afternoon feeding foray in Yellow Gum/Red Ironbark. During the middle of the day they cohabitate with White-plumed Honeyeaters amongst the Manna Gums, Yellow Box, Swamp Gums and Silver Wattles close to the river and in adjacent gullies. Here they glean scale insects such as leaf psyllids and their honeydew exudates and manna (sap) from the leaves and branches.

Yellow-faced Honeyeater. They are resident at Yarrambat in small numbers in spring-summer but populations fluctuate seasonally at other times of the year. Every five to eight years, when both Red Ironbark and Yellow Gum flower heavily, a large autumn-winter influx of birds, possibly from the ranges, occurs into the Yarrambat ironbarks. About 200 birds were present in the 5 ha stand during the censuses of 1977 and 1983. This was the highest density recorded in NEM. Numbers have declined over the last decade. They spend about equal amounts of time gleaning and hawking for foliage insects and taking nectar. Each activity occurs at all tree and shrub levels.

Yellow-tufted Honeyeater. They are annual late summer to late winter migrants from inland Victoria and possibly from the Bacchus Marsh–Brisbane Ranges area west of Melbourne to the flowering Manna Gums, Red Ironbarks and Yellow Gums at Yarrambat. They spend about equal amounts of time in the mid-tree and tall shrub layers, on foliage gleaning for invertebrates and nectar taking from heavy flowering eucalypts and shrubs. The staple diet is eucalyptus psyllids and their honeydews (particularly from Yellow Box) but they also take manna exudates from leaves, branches and trunks of eucalypts and wattles. Up to 30 birds visited the Yarrambat ironbarks in prolific flowering years of the 1970s (e.g. 1977) but populations have undergone a dramatic decline and seldom more than two or three at a time have been seen in recent years.

White-plumed Honeyeater. They are sedentary and territorial. Rare in the box–ironbark woodland away from the river in 1977, they profited from adjoining land clearing and are now the fourth most common nectivore on the census plot. They are the dominant honeyeater amongst Manna Gums along the river and enter the box–ironbark woodland during the autumn-winter flowering season. They spend about equal amounts of time taking nectar and invertebrates. Major invertebrate dietary components are scale insects such as psyllids and their exudates taken while gleaning the foliage canopy. A small proportion of the insect intake is from hawking. Manna exudates from eucalypts and Silver Wattles form an important component of the diet. Nectar is taken from flowering Red Ironbarks, Yellow Gums, mistletoes and shrubs (when available).

White-eared Honeyeater. A few pair reside in the deep gullies at Yarrambat. They are more common on the Plenty–Janefield sand-plain where dense thickets of Burgan are present. Additional birds are annual autumn–winter migrants as part of a non-breeding altitudinal movement from the ranges. These become sedentary and

form small feeding territories. White-eared Honeyeaters take invertebrates from under loose bark of the trunks and branches of tall shrubs and trees (particularly Yellow Gums and Manna Gums at Yarrambat) and also glean foliage insects and their honeydew (particularly psyllid lerp) and manna exudates such as from Sugar Glider feeding scars in the mid-levels of eucalypts and wattles. They take nectar mostly from shrubs but feed from flowering Red Ironbarks during the morning and both Yellow Gums and Red Ironbarks during the late afternoon, when they often sally from vantage points over water for swarming insects. They are an aggressive species to other honeyeaters but are cautious of humans in bushland gardens and seldom enter those containing domestic cats.

Phylidonyrids: Crescent Honeyeater. Several pair were breeding residents at Yarrambat in the 1970s but this ceased in the latter census years. They now only visit during autumn–winter, as part of a non-breeding altitudinal movement from the ranges. They collect manna exudates and insects and their honeydew exudates from the leaves and branches of mid-strata Silver and Black Wattles and Blackwoods in gullies and on densely wooded hill-slopes. They hawk for insects, often nectar-seeking species, amongst flowering Red Ironbarks and Yellow Gums. They also probe the middle and lower branches of eucalypts and tall wattles for bark and crevice invertebrates.

At Yarrambat they take nectar from Box Mistletoe through the day and from Red Ironbarks during the morning nectar flow and less often from Yellow Gum and Red Ironbarks in the late afternoon. They join (with the White-eared Honeyeater) flocks of foliage insectivores, but most often are involved in insect hawking. A high proportion of their nectar is from low shrubs such as the Rock Correa and Rosemary Grevillea. They hawk for insects in the early morning and late afternoon from a vantage on top of a tall shrub, particularly amongst Burgan or Cherry Ballart thickets. They are territorial while feeding, forming loose groups of a few pairs.

New Holland Honeyeater. They are resident along the Plenty River, forming feeding groups of 10–15 birds. They move locally following nectar flows and feed on nectar as it becomes available from different plant species more or less continuously through the day. Their most important food in autumn is nectar from Box Mistletoe on Yellow Box and Yellow Gum and Creeping Mistletoe on the Red Box, Long-leaf Box and River Red Gum. At Plenty–Janefield, flowering Grey Mistletoe on Silver Wattles along the river is a major attraction. Other winter nectar food-plants include the Common and Rock Correas, Red Ironbark and Yellow Gum. In spring, their main nectar supply is from River Bottlebrush and flowering Drooping Mistletoe on Red Ironbark, Manna Gum, Yellow Gum, Red Stringybark and Yellow Box.

Feeding flocks enter the canopy of Red Ironbarks during the morning nectar flow and Red Ironbark and Yellow Gum for surpluses in late afternoon during strong flows. New Holland Honeyeaters become highly territorial while nectar feeding. A population concentration of up to 50 birds gathers at Yarrambat ironbarks in winter. During periods of the day when nectar is not readily available, the diet is supplemented by hawking from exposed perches for insects. Manna and honeydew exudates and invertebrates are gleaned from foliage or probed from branches of eucalypts and wattles. The New Holland Honeyeater has increased in numbers in the gorge.

Tawny-crowned Honeyeater. They were regular and not infrequent autumn-winter visitors in the 1970s but have become extremely rare in recent years (one bird seen once since 1983, in June 1988). There was an influx into the gorge and birds were seen locally for several months in the inland dry years of 1977 and 1983. Normally they remain for a few days while in passage from breeding grounds along the coast to inland feeding grounds. They take nectar from low shrubs, particularly Rock Correa and Common Correa and probably the Tree Banksia and Rosemary Grevillea. They briefly enter the canopies of Red Ironbark and Yellow Gum during nectar flows. They also take nectar from flowering mistletoes and opportunistically hawk around blossoms for nectar-seeking insects.

Other nectivores: Regent Honeyeater (see Rare or Threatened Fauna).

Bell Miner. They first appeared in the census plot after the 1982 drought. They form communal and highly territorial colonies of 10–20 birds along the river and the broad floodplain of confluence valleys, each group holding a permanent territory of 1–2 ha. In favourable sites, as many as four or five adjacent colonies can occupy an area as small as 10 ha. From late summer to early winter, juveniles move into nearby unoccupied habitat. Bell Miners glean invertebrates and their honeydews, particularly the sugary exudate (lerp) of psyllid

insects from the mid-tree and tall shrub strata. Most activity in flowering Red Ironbark and Yellow Gum is on nectar-seeking insects. Small quantities of nectar are also taken.

Red Wattlebird. They are resident at Yarrambat, forming loose colonies of 10-20 birds. Large, mobile autumn-winter flocks form in the 5 ha stand of ironbarks. During prolific flowering years 200-300 birds are present. These flocks follow local nectar flows, aggregating in Red Ironbark during the morning nectar peak and in Yellow Gum/Red Ironbark in late afternoon. They were present in the census plot throughout the day but switch their feeding activities depending on food supplies. Insect hawking is principally conducted in early morning as insects rise when warmed by the sun from their foliage roosts and before dusk as they swarm in preparation to roost. Foliage and blossom gleaning for insects occurs throughout the day. They take nectar, insects and fruit from all tree and shrub layers and are territorial over food supply with other species of nectivores at all times. The number of Red Wattlebirds increased over the 15 year census period.

Little Friarbird. In the early 1970s they were annual summer visitors from northern Victoria or further inland (40 birds seen in 1977 at Yarrambat). They are now rather nomadic and irregular, visiting about once in five to ten years and seldom seen in groups of more than five or six. They are mobile and follow flowering eucalypts. In recent years they have only been seen at Yarrambat in late summer, when Manna Gum is flowering. In the 1970s they stayed on through autumn and winter in prolific flowering years of Red Ironbark and Yellow Gum. This nectar-follower also feeds on insects and fruit taken from trees, mistletoes and tall shrubs.

Eastern Spinebill. A few birds are resident at Yarrambat but numbers fluctuate with local food availability. They are locally mobile and take nectar from Common Correa, Rock Correa, Rosemary Grevillea, mistletoes and occasionally Red Ironbark and Yellow Gum. They are common in house gardens in the district and in areas containing flowering Common Heath (now eliminated from the gorge).

CI 40^b: High diversity of reptiles—Yarrambat ironbarks to Morang Wetlands census, November 1988. Seventeen species were recorded in a 3-hour search on 13 November 1988 from Yarrambat ironbarks, over the rapids and sheltered escarpment of Eagle Point, to Wallaby Rocks and along Wilton Vale Creek to Morang Wetlands. This was the highest single day census diversity recorded in the NEM study. Habitats traversed in order of meeting included: Red Ironbark–Yellow Gum box–ironbark woodland (12.2; Yarrambat ironbarks); Golden Wattle cliff/escarpment shrubland (20.4; Yarrambat ironbarks); Manna Gum floodplain riparian woodland–terrace (16.5; below Yarrambat ironbarks); Muttonwood riparian scrub (18.1; Eagle Point rapids); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; Wallaby Rocks); Long-leaf Box–Manna Gum escarpment woodland (13.1; opposite Yarrambat ironbarks and flanking Wilton Vale Creek); Manna Gum gully woodland (10.1; Wilton Vale Creek); Yellow Box–Hill Manna Gum (volcanic) grassy woodland (14.2; west of middle Wilton Vale Creek); River Red Gum (volcanic) grassy woodland (14.1; south-east side of Mother-In-Law's Leap); Common Reed–Cumbungi seasonal wetland (25.7; Mother-In-Law's Leap). Significant species included:

- Common Long-necked Tortoise: four juveniles in the pool below Eagle Point rapids (18.1)
- Tree Dragon: three at Yarrambat ironbarks (12.2)
- Large Striped Skink: one in grassland under rocks east of Mother-In-Law's Leap (14.1); becoming uncommon in PGP
- Cunningham's Skink: one in the basalt cliffs at Wallaby Rocks (20.5)
- White's Skink: one along lower Wilton Vale Creek (10.1); uncommon in gullies and grassy escarpments (13.1) of PGP
- Blotched Blue-tongued Lizard: one in a cage trap on a gravel spit at Eagle Point rapids; (18.1); restricted to the river in PGP
- Delicate Skink: 10 under basalt rocks east of Mother-In-Law's Leap (14.1); rare elsewhere in PGP and on basalt in NEM; also recorded in Yellow Box–Red Stringybark box–stringybark woodland (11.2) on the grassy spurs north of Archery Gully
- Weasel Skink: one on the sheltered escarpment of Eagle Point (13.1); not recorded in PGP previously but subsequently located under Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2) on sheltered cliffs opposite Wilton Vale Farm on 24 January 1991, and at Rapaport on 12 February 1996

- Bougainville's Skink: two under loose shale on the Yarrambat ironbarks cliff (20.4) and one under a small rock in crumbly red gradational soil on a stony crest east of Mother-In-Law's Leap (14.1)
- Tussock Skink: two in stony plains grassland east of Mother-In-Law's Leap (14.1)
- Eastern Brown Snake: one above Wilton Vale Creek (14.2)
- Red-bellied Black Snake: one at Mother-In-Law's Leap (25.7); becoming rare in PGP
- Lowland Copperhead: one on the terrace below Yarrambat ironbarks (16.5)

Db **40^b: Highest diversity of avifauna in Greater Melbourne (GM).** Over 160 species of native birds were recorded at Yarrambat–Morang Wetlands. This was the only 1' or 2' grid in GM to have a contemporary native bird assemblage in excess of 150 species. The site has a unique faunal composition. No area of equivalent size (2.1 km²) in Victoria, and few elsewhere in Australia, has an equal native vertebrate fauna diversity (over 220 species). Yarrambat–Morang Wetlands is the highest ranking site of faunal significance in NEM. With the exception of internationally significant coastal wetland sites on the western shore of Port Phillip, it is the highest ranking site in GM. Nowhere else in GM contains such a high diversity and strong representation of species in all terrestrial vertebrate groups (i.e. birds, mammals including bats, frogs and reptiles). The site supports the highest representation of regionally threatened, rare or depleted fauna in GM (84 species).

Dc **40^b: High diversity of mammals.** Twenty-five species were recorded. This includes a Feathertail Glider seen by Paul Peake in Silver Wattles while spotlighting along the river adjacent to the Yarrambat Ironbarks on 18 March 1990 (Manna Gum floodplain riparian woodland; 16.4).

Dd **40^b: High diversity of herpetofauna.** Thirty-two species were recorded in the Yarrambat 1' grid, richest area for reptiles and frogs in the NEM survey. This was largely due to the juxtaposition of different geological and topographical landforms and habitats which combine to give three ecological assemblages (biotas). These are:

- volcanic plains: grassy woodland (14.1/14.2) and (volcanic) cliff/escarpment shrubland (20.5). Species include the Marbled Gecko, Large Striped Skink, Cunningham's Skink, Common Blue-tongued Lizard, Little Whip Snake, Tussock Skink, Bibron's Toadlet and Common Spadefoot Toad.
- lowland hills: herb-rich foothill forest (6.1), gully woodland (10.1), box–stringybark woodland (11.1/11.2), box-ironbark woodland (12.2), escarpment woodland (13.1/13.3) and (sedimentary) cliff/escarpment shrubland (20.2/20.4). Species include the Tree Dragon, White's Skink, Weasel Skink, Delicate Skink, Eastern Small-eyed Snake, Lowland Copperhead and Victorian Smooth Froglet (recorded nearby in Smugglers Gully).
- alluvial plains (streamway and swamps): floodplain riparian woodland (16.4/16.5), riparian scrub (18.1) and seasonal wetland (25.1/25.7). Species include the Blotched Blue-tongued Lizard, Southern Water Skink, Red-bellied Black Snake and Peron's Tree Frog. The non-indigenous Murray River (short-necked) Tortoise is common in North East Wetland, where it lays eggs in burrows in sunny locations at the top of the cliffs. The Common Long-necked Tortoise is mostly seen in pools along the river, where it lays eggs in burrows on the sandy terraces.

There are several co-occurrences of herpetofauna species at Yarrambat that are of biogeographical interest. It is an important overlap area of the small elapids, the Little Whip Snake and Eastern Small-eyed Snake. The Little Whip Snake is widespread on the basalt plains west of the river. Their occurrence on the sedimentary eastern escarpment is rare in this geological type. Likewise the Eastern Small-eyed Snake, which occurs elsewhere in NEM exclusively on sedimentary and granitic types, can be found on the basalt sections.

Fa **40^b: High population density of Latham's Snipe at Wilton Vale Marsh.** Thirty Latham's Snipe (and others uncounted) were recorded in the 1 January 1996 census. They commence arriving at Wilton Vale Marsh in September. Sixteen were counted in a visit on 15 October 1996. Numbers build over the following months as water recedes and mudflats are exposed and they depart around mid-January. As fringing freshwater meadows (25.1) develop over coming years, snipe numbers at the marsh will increase. Only a few sightings of one or two birds had previously been made in the park.

Other Significant Fauna

Birds

Eb **40^b: Glossy Ibis at Wilton Vale Marsh.** One was first seen on 31 October 1994; it was joined by a second bird in November (Mark Tscharke pers. comm.). The birds mainly foraged while wading knee-deep in the shallows, particularly amongst the Common Spike-sedge beds (seasonal wetland; 25.1). They probed in the mud substrate and amongst emergent vegetation for aquatic insect larvae, molluscs and crustaceans. They also take terrestrial insects. The movements and range of the Glossy Ibis are nomadic but they appear partial summer migrants to inland Victoria from northern Australia. They are regarded as vagrants to southern Victoria, mostly after inland droughts. The only other recent sighting in NEM. was at Dunnetts Road Swamp (site 38), also in October 1994.. Prior sightings were in 1978/79 at La Trobe University (site 26) and Dunnetts Road Swamp, after the 1977 drought.

Eb **40^b: Intermediate Egret at Wilton Vale Marsh.** Three Intermediate Egrets were present at Wilton Vale Marsh on 1 January 1996, where they were observed foraging in the Common Spike-sedge shallows (seasonal wetland; 25.1). A small flock had been previously seen in May 1983 (after the break of the 1982 drought), in flooded grassland along Wilton Vale Creek (River Red Gum (plains) drainage line woodland (30.1)). There have been only two other sightings in the last decade in NEM (Towts Swamp, site 37 and Birrarung Park, Templestowe, site 33). They are rare and sporadic visitors (mainly late summer–autumn) from the inland riverine plains. The introduction of native fish to the Morang Wetlands may attract more visiting Intermediate Egrets.

Eb **40^b: White-bellied Cuckoo-shrike.** This species has been a rare visitor over the last 20 years, being seen on only two occasions. A pair nested in a copse of regrowth River Red Gums (grassy woodland; 14.1) near Wilton Vale Marsh in November 1995.

Ec **40^b: Spotless Crake.** One was observed in reed beds along the river downstream of Yarrambat falls in the 1982 drought (Manna Gum floodplain riparian woodland; 16.4). Another was observed in Common Reed–Cumbungi seasonal wetland (25.7) at Mother-In-Law’s Leap in December 1995 (Mark Tscharke pers. comm.). The tall cover/bare shoreline combination is ideal for this and the Australian Spotted Crake. Expect both species will be recorded at Wilton Vale Marsh.

Ec **40^b: Black-tailed Native Hen at Wilton Vale Marsh.** Two birds were present on the north-east shoreline of Wilton Vale Marsh on 16 September 1996 (Rush Sedge–Common Spike-sedge seasonal wetland; 25.1). They were timid and splashed over the top of the water to cover in the north-west section. The native hens were not observed when the marsh was visited three days later but may have been elsewhere in Morang Wetlands, or possibly had moved on. They frequent River Red Gum marshland, in GM more typically cane-grass and lignum swamps of the Werribee Plains. The only other locality in NEM at Dunnetts Road Swamp (site 38) was of similar habitat to Wilton Vale Marsh.

Black-tailed Native Hens mainly forage amongst vegetation above the shoreline, where they take seeds and vegetable material. They also turn over litter and peck in damp mud for molluscs, insects and crustaceans. The mud-spits exposed by receding water at Wilton Vale Marsh appear ideal foraging areas. Planting Swamp Paperbark above the shoreline and Blackwood and Common Tussock-grass on the batters would provide additional security and habitat. Placing logs in the shallows around the spits would further enhance their habitat. Native hens are vagrant to southern Victoria except for sporadic influxes influenced by an exodus of birds from the inland after seasons of high breeding productivity (such as 1996/97).

Ec **40^b: Breeding Black-winged Stilts at Wilton Vale Marsh.** Prior to 1995, the only record of the Black-winged Stilt in Plenty Gorge Park was in 1986, when a single bird briefly visited Mother-In-Law’s Leap. Five pair spent spring 1995 at Wilton Vale Marsh. One pair bred and remained until January 1996. The nest was a platform of dry grass and sedge, lying in shallow water in Rush Sedge–Common Spike-sedge seasonal wetland (25.1). They reared one young. Five pair were again recorded on visits in October/November 1996. Each appeared to be nesting. On 15 October, one had laid four olive-green, brown-mottled eggs in a scrape in dry mud (no nest material) on a small island. The others were nesting amongst beds of Common Spike-sedge. On 8 and 11 November, two of the pairs (likely with young) took up ‘broken-wing’ distraction behaviour when approached. On 11 November, three chicks were observed with one of these pair. The nests were well spaced around the wetland.

When humans visit the wetland, the stilts spend most of their time in the air calling. When they settle, they feed by slowly moving through shallow water (to 15 cm deep), pecking small molluscs, aquatic insects and crustaceans from the water or damp mud on the shoreline. Human disturbance at the wetland needs to be kept to a minimum while the stilts are breeding.

Ec **40^b: Whiskered Tern.** They are rare summer migrants from the far north. During inland droughts they irrupt in larger numbers into southern Victoria. Six birds were seen at Wilton Vale Marsh on 1 January 1996. Two birds had been previously seen in late October 1988 over rank grassland in the upper Wilton Vale Creek floodplain. Several other observations were made at this time in GM. The flooded Common Spike-sedge beds (seasonal wetland; 25.1) form potential breeding habitat. **Over** the last decade, Whiskered Terns were recorded only at five other locations in NEM. These were O'Herns Road Wetlands (site 12), Darebin Creek near La Trobe University (site 23), near Bolin Swamp (site 32), Towts Swamp (site 37) and farm lakes at Yan Yean (site 39).

Ec **40^b: Red-necked Stint and other potential international migratory shorebirds at Wilton Vale Marsh.** Four Red-necked Stilts were observed along the open western shoreline of Wilton Vale Marsh on 8 November 1996. It is likely that other international migratory waders will visit the wetland over the summer drawdown period. Visiting species may include the Greenshank, Wood Sandpiper, Marsh Sandpiper, Curlew Sandpiper and Sharp-tailed Sandpiper in late summer and Double-banded Plover in autumn/winter. These have each been recorded at shallow freshwater marshes on the Plenty Alluvial Plains (see sites 37, 38 and 39). The wetland still has several years before detritus from aquatic vegetation in the deeper water and populations of invertebrate detritus feeders on the mudflats develop fully.

Ed **40^b: Breeding Red-kneed Dotterel at Wilton Vale Marsh.** This species is more common at the cane grass and lignum swamps of the Werribee Plains. There have been few observations in NEM These include O'Herns Road Wetlands (site 12), Darebin Creek near La Trobe University (site 23), near Bolin Swamp (site 32), Towts Swamp (site 37) and Yan Yean farm lakes (site 39). Morang Wetlands is one of only two confirmed breeding locality. They inhabit freshwater wetlands and are partial summer migrants to Victoria. Numbers present in GM depend on seasonal conditions inland.. Several pair have annually visited and bred at Morang Wetlands over the last decade. Two were nesting at Wilton Vale Marsh on 10 November 1996. Eggs are laid in a small depression of the ground amongst tussocks on the islands rather than on the bare shoreline like the Black-fronted Dotterel. They feed by wading in the mudflat shallows while the dotterel feeds at the shoreline.

Ee **40^b: Swamp Harrier at Morang Wetlands.** The first sighting of a Swamp Harrier in Plenty Gorge Park was at Wilton Vale Marsh on 1 January 1996. On 1 November 1996, an adult bird was observed at North East Wetland sitting on a raft (1 m in diameter in about 0.3 m of water) of Tall Spike-sedge constructed by nesting Eurasian Coots (Mark Tscharke pers. comm.). This species will likely nest in the future when areas of Tall Spike-sedge expand, provided disturbance from humans in the breeding season is kept to a minimum.

Ef **40^b: Cattle Egret roost at Wilton Vale Marsh.** Night roosts are provided by the River Red Gums. From March to October 1996, over 50 (68 on 15 October) roosted at the wetland. Numbers will likely increase in future years.

Eg **40^b: Breeding Peregrine Falcon and Wedge-tailed Eagle.** The old Wedge-tailed Eagle eyrie on the Plenty River has been the breeding site of a pair of Peregrine Falcon for over five years. A pair nested on a ledge in the face of the Gordons Road quarry before infilling began around 1990. Young have been banded by NRE officers in recent years (two fledglings on 15 October 1996). The traditional Wedge-tailed Eagle eyrie was abandoned in the early 1980s but nesting resumed in a more remote section around 1993. Young have been reared most years since but several have been electrocuted on SEC transmission stanchions. Disturbance from humans in the breeding season would likely prevent both species from nesting.

40^b: One of the most important habitat links for birds in GM. The site provides a habitat link for upland damp forest birds moving between areas of high faunal significance in the Hume Ranges and Kinglake Ranges to the Yarra River. Species include the Gang-gang Cockatoo, Yellow-tailed Black-Cockatoo, Brush Cuckoo, Rufous Fantail, Pink Robin, Rose Robin, Olive Whistler, Cicadabird (Plenty-Jane-field), Bassian Thrush, Red-browed Treecreeper, White-eared Honeyeater, Crescent Honeyeater, Pied Currawong and Australian Raven. The site contains the most complete overlap in GM of these species with avifauna characteristic of the grassy woodlands and box-ironbark woodlands of inland Victoria.

Species indicative of the latter area include the Crested Pigeon, Spotted Harrier, Black Kite, Black Falcon, Little Corella, Cockatiel, Dollarbird, Rainbow Bee-eater, Black-eared Cuckoo, Red-capped Robin, Hooded Robin, White-winged Triller, Southern Whiteface, Rufous Songlark, Masked Woodswallow, White-browed Woodswallow, Brown Treecreeper, Black-chinned Honeyeater, Regent Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater, Little Friarbird and Diamond Firetail.

40^b: Refuge for avian drought visitors. Yarrambat and the You Yangs provide the two most important drought refuge areas for inland migratory birds in GM. Many short and some long-term changes to the avifauna at Yarrambat occurred with the irruptions of birds from inland and northern Australia during the droughts of 1977/78 and 1982/1983. The species involved included the Black-winged Stilt, Little Egret, Intermediate Egret, Black-tailed Native Hen, Whiskered Tern, Painted Snipe, Pink-eared Duck, Little Corella, Cockatiel, Spotted Harrier, Black Kite, Budgerigar, Dollarbird, Rainbow Bee-eater, White-bellied Cuckoo-shrike, White-winged Triller, Southern Whiteface, Rufous Songlark, Masked Woodswallow, White-browed Woodswallow, Black-chinned Honeyeater, Regent Honeyeater, Yellow-tufted Honeyeater, Fuscous Honeyeater, Tawny-crowned Honeyeater, Black Honeyeater, Noisy Friarbird, Little Friarbird and Diamond Firetail.

Most of these species are regionally threatened, rare or depleted in GM. Some are regarded as vagrant to southern Victoria (e.g. Black Honeyeater). These species have been only sparingly seen since the 1983 drought at Yarrambat (e.g. during small influxes in 1986, 1988 and 1991), but never many individuals and never all at once. Many, such as the Regent Honeyeater and Little Friarbird, were annual visitors in the early 1970s but now infrequently visit. Some, such as the Budgerigar and Noisy Friarbird, have not been seen since, while the Cockatiel and Dollarbird have been seen only once over the last decade. These all nested in the Manna Gums along the river. Others, such as the Little Corella, which appeared for the first time in 1977, came to stay.

Mammals

Ec **40^b: Eastern Freetail Bat.** Eleven species of insectivorous bats were recorded at Yarrambat–Morang Wetlands. This was the most diverse assemblage in the survey of Greater Melbourne. The last species to be recorded was on 1 January 1996. A male Eastern Freetail Bat was taken in a bat trap set over a track near Wilton Vale Marsh in River Red Gum (volcanic) grassy woodland (14.1). One had been trapped in 1991 in similar habitat about 2 km to the north, near the river on the Yan Yean flume track (Plenty River Mernda, site 16).

Ed **40^b: Goulds's Long-eared bat.** This species is widespread in upland wet and damp sclerophyll forests in the Plenty River Headwaters and Kinglake National Park. A post-lactating female was trapped along with the Eastern Broad-nosed Bats on 24 January 1991 at the upstream end of Yarrambat pool. It may have bred locally but since this species is not normally associated with the lowlands, its capture at Yarrambat may indicate a functional habitat link between the uplands and the gorge. The trap was set in the water under overhanging shrubs and amongst mating swarms of insects at the point where the running riffles break into standing water. The habitat was Muttonwood riparian scrub (18.1) upstream of Manna Gum (riverbank) floodplain riparian woodland (16.4).

Ed **40^b: Grey-headed Flying-fox at Yarrambat ironbarks.** A noisy feeding flock of six to eight was observed in flowering Red Ironbark–Yellow Gum box–ironbark woodland (12.2) at Yarrambat on the evening of 4 June 1996. With the substantial increase in size of the roosting colony at the botanic gardens (now several thousand), sightings in the northern suburbs have become more frequent. When strong nectar flows occur in stands of ironbark in outlying districts, troops of flying-foxes venture some distance from the roost.

Ee **40^b: Platypus.** Possibly eight to ten animals reside in the Plenty Gorge; one or two are resident in the Yarrambat pool. Upstream of Blue Lake at Plenty–Janefield, Platypus have been resident at spacings of 2 to 3 km over the last 20 years. They were last observed in the urban section of the river below Janefield in the early 1980s. Increased levels of water pollution and destruction of breeding and feeding habitat has eliminated them in recent years. Lowered water quality in upstream sections of the gorge has occurred due to development at Mernda, the commissioning of the Cades Road sewage treatment plant and poor land management in the floodplain mid-reaches of the Plenty River (see Dunnetts Road Swamp–Cades Road site and Towts Swamp site).

Reptiles

Ed **40^b: Eastern Small-eyed Snake.** Numerous observations of single animals have been made in Plenty Gorge Park over the last decade. A find of about 50 animals in communal hibernation was made under debris in the basalt margin of a small pond in Morang Wetlands on 15 September 1996 (Mark Tscharke pers. comm.). This consisted of two groups (about 40 and 10 individuals) composed of equal numbers of juveniles, sub-adults and adults. The snakes were interwoven into tight clusters.

Freshwater fish

40^b: Paucity of native fish and abundance of Roach. Apart from the Short-finned Eel, only two other species of native fish were recorded in the river at Yarrambat during the 1988/89 fish survey (McKenzie & O'Connor 1989). These were seven Flat-headed Gudgeons and one Common Galaxias. The galaxias was electrofished upstream of Eagle Point. Most of the gudgeon were obtained from the rapids and riffles at Wilton Vale Farm, immediately upstream of the Yarrambat pool. Six fike nets and four mesh nets were set overnight on 25 January 1989 in Yarrambat pool for a return of only two Short-finned Eel, one Goldfish and two Roach (McKenzie & O'Connor 1989).

A Platypus was seen in the pool through the night and the nets were checked at frequent intervals as a routine precautionary measure. Fike nets (as opposed to drum nets) are set with the roof protruding from the water in the event of trapping air-breathing mammals and tortoises. Platypus drown in a submerged drum net and as a result their use is now prohibited in 'platypus waters' of Victoria. Large populations of the introduced Roach were present in the small cascades and pools and running riffles between Eagle Point and the Yarrambat falls and in the riffles on Wilton Vale Farm (100 were electrofished in the latter location).

40^b: Electrofishing Survey: Plenty River–Plenty Gorge at Wilton Vale rapids

Map reference. 7922 336344. **Altitude.** 140 m. **Survey date.** 15 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank: Muttonwood riparian scrub (18.1; poor condition dominated by alien shrubs including White Crack Willow, Hawthorn and Blackberry). Frontage: Yellow Box–Red Stringybark box–stringybark woodland (11.2; above south/west side of river; fragmented and poor condition); Long-leaf Box–Manna Gum escarpment woodland (13.1; north/east side of river; fair condition but invaded by alien shrubs and herbs); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; south/west side columnar basalt cliffs; poor condition)

Physical Features:

Pools

Substrate. Silt, logs and willow roots on sheet sandstone

Maximum size (mid-summer). 12 m wide by 1.6 m deep by 100 m long

Riffles

Substrate. Basalt and sandstone boulders, gravel and sand on sheet sandstone

Flow (mid-summer normal): **Size.** 2.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 12 ML/day

Water quality

Summer: Temperature. 23°C. **Conductivity.** 600 ms. **Turbidity.** Moderate

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (6); migratory sub-adult. Flat-headed Gudgeon (5); likely breeding resident

Alien species numbers/status. Roach (100); likely breeding resident. Mosquito Fish (20); likely breeding resident

Other comments. The sheet rock substrates of the Plenty Gorge support less aquatic vegetation than upstream in the Plenty Alluvial Plains at Yan Yean. This would have originally supported low numbers of Southern Pygmy Perch but these have been apparently eliminated. Land tenure: Plenty Gorge Park on west side and landscape interest on east side. The west side was formerly farmland. The land zoning along the east side should be upgraded to conservation.

40^c: Electrofishing Survey: Plenty River–Plenty Gorge, Yarrambat pool above falls

Map reference. 7922 343341. **Altitude.** 140 m. **Survey date.** 15 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum (riverbank) floodplain riparian woodland (16.4; fair condition). Frontage: Manna Gum (river terrace) floodplain riparian woodland (16.5; fair condition); Yellow Box–Red Stringybark box–stringybark woodland (11.2; spurs above both sides of the river; fair condition); Golden Wattle cliff/escarpment shrubland (20.4; sandstone cliffs; 20.4; fair condition)

Physical Features:

Pools

Substrate. Deep silt on sheet sandstone

Maximum size (mid-summer). 20.0 m wide by 6 m deep by 900 m long

Riffles

Substrate. Sandstone cobbles on sheet sandstone; waterfalls descending 3.0 m

Flow (mid-summer normal): Size. 2.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 12 ML/day

Water quality

Summer: Temperature. 22°C. **Conductivity.** Not recorded. **Turbidity.** Moderate

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (9); migratory sub-adult

Alien species numbers/status. Goldfish (1); likely breeding resident. Roach (5); likely breeding resident

Other comments. Yarrambat pool is a deep waterbody, nutrient enriched from upstream runoff. Water at depths below 1.5 m has low dissolved oxygen and relatively high turbidity levels. This restricts aquatic vegetation and invertebrate life. Platypus are still present. Freshwater Blackish were present in the 1970s. Land tenure: Plenty Gorge Park.

40^b: Electrofishing Survey: Plenty River–Plenty Gorge at Eagle Point rapids

Map reference. 7922 335335. **Altitude.** 135 m. **Survey date.** 15 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank: Muttonwood riparian scrub (18.1; excellent condition). Frontage: Long-leaf Box–Manna Gum escarpment woodland (13.1; downstream west side of river; good condition); Red Box escarpment woodland (13.3; upstream east side; good condition); Golden Wattle cliff/escarpment shrubland (20.4; Yarrambat ironbarks, downstream east side; good condition); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; Wallaby Rocks, upstream basalt cliffs on west side; good condition)

Physical Features:

Pools

Substrate. Deep silt, basalt and sandstone boulders and logs on sheet sandstone

Maximum size (mid-summer). 6.0 m wide by 2.0 m deep by 200 m long

Riffles

Substrate. Sandstone and basalt cobbles and gravel on sheet sandstone

Flow (mid-summer normal): Size. 2.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 12 ML/day

Water quality

Summer: Temperature. 22°C. **Conductivity.** 330 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Common Galaxias (1); passage migrant

Alien species numbers/status. Roach (35); likely breeding resident

Other comments. Freshwater Blackfish, though not electrofished, are still present in some of the pools in this section. Water Rats were also present. The water in this section would have more than likely been breeding grounds for the Australian Grayling (now regionally extinct and vulnerable in Victoria). With the fish-way installation at Dights Falls and removal of a weir at Janefield south, grayling would be able to move up the system. It remains to be seen how they would cope with the reduced river flow, declining

water quality and large populations of Roach which would be food competitors and predators of their eggs and fry. Land tenure: Plenty Gorge Park.

Butterflies

40^b: Yarrambat–Morang Wetlands. Twenty-four native species excluding migrants have been recorded. Significant species include the Phigalia Skipper, Chequered Blue, Small Copper, Dark Purple Azure and Olane Azure. The Small Copper is primarily associated with volcanic plains grasslands in NEM and is uncommon in the site. The larvae feed on Grassland Wood-sorrel.

40^c: Clements Gully. The gully supports remnant Manna Gum gully woodland (10.1). Yellow Box–Red Stringybark box–stringybark woodland (11.2) above the gully was cleared around 1964 and livestock graze to the southern edge. In 1987, three upland species that are very rare in the lowland hills of NEM were still present (Spotted Brown, Bank’s Brown and Bright Copper). They have not been located in recent years as the gully has become choked with Blackberry and other weeds. The larvae of the Spotted Brown feed on Slender Tussock-grass. Those of the Bright Copper feed on Sweet Bursaria and are attended by a small, black ant (*Iridomyrmex* sp.). Most of the habitat adjacent to Clements Gully supporting the bursaria has been eliminated or degraded. The Bright Copper is regionally vulnerable in GM and the Spotted and Bank’s Browns have become very rare in the lowland hills due to grazing and clearing of sheltered valleys and gullies.

MANAGEMENT

Threatening Processes	Conservation Measures (see also Conservation Measures under the Regional Habitat Link Strategy: Melbourne Parks & Waterways management—Appendix 4.1)
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Regional Habitat Link Strategy

Habitat connectivity. Intact streamway habitat link downstream to the Kurrak Road site and upstream to the Mernda site. Partial overland link to the Plenty River–Diamond Creek Link site. The Yarrambat ironbarks provide feeding habitat for the highest avian nectivore species richness and density recorded in GM. It is the only site in GM where the Regent Honeyeater has been recorded repeatedly and breeding in recent years. The diverse woodland habitats of the site provide one of the most important areas in GM for inland migratory birds.

Mammal decline and habitat loss and habitat link fragmentation. The Yarrambat section of the gorge forms the closest approach of viable populations to the Melbourne CBD for a number of mammal species. These include the Brush-tailed Phascogale, Common Dunnart, Feathertail Glider, Common Wombat and Black Wallaby. Each of these species is now locally threatened by habitat loss, fragmentation and degradation induced by farmland clearing and residential encroachment. Further fragmentation or loss in effectiveness of external habitat links will be reflected in losses in the abundance and local distribution of fauna.

Clearing and urban encroachment is threatening rare honeyeaters. Several species of honeyeaters (e.g. Regent, White-eared, Fuscous, Black-chinned, Crescent and Yellow-tufted) have noticeably declined in the Yarrambat ironbarks over the last two decades. The loss of habitat through clearing has restricted the range and abundance of these species. The populations of visiting nectarfauna from the inland have also declined due to clearing, logging and degradation (e.g. insect-related dieback problems) of Red Ironbark woodlands in north-central Victoria.

The local decline of nectar-producing shrubs, particularly the Common Heath, Tree Banksia and Rosemary Grevillea (each present at Yarrambat ironbarks in the 1970s but now absent), has depleted the shrub layer nectivores. This has particularly affected breeding populations of White-eared and Crescent Honeyeaters and visiting populations of the Tawny-crowned Honeyeater. Clearing and/or grazing of bushblocks in the vicinity of the gorge is also having a severe effect on these species.

The Regent Honeyeater was observed in flowering Manna Gums at the mouth of Clements Gully in the late 1970s. It is now unlikely to visit the area due to the colonisation of the linear woodland remnants by a large population of Bell Miners.

Yarrambat ironbarks—upper Smugglers Gully revegetation program. Over 10 ha of cleared land is currently under revegetation between Yarrambat ironbarks and Smugglers Gully. This will join the two areas. The plots are part of a long-term program to extend the habitat of the Regent Honeyeater and to improve overland habitat links between the two areas for species such as the Tree Dragon and Brush-tailed Phascogale. Along with canopy species, ground and shrub flora are being planted and weed control measures are being undertaken.

The establishment of plantation strips or clumps of less than 5 ha favours species which occupy forest edges such as the Bell Miner and Noisy Miner. These areas do not normally support foliage birds such as the Regent Honeyeater.

The cause and effect of habitat fragmentation, expanding miner populations, eucalyptus dieback and foliage bird decline is fully documented in Volume 1.

Census studies determined that fragmented stands contain a high edge to interior habitat ratio. Edges occupy a strip 40–50 m wide. The ratio of interior to edge habitat of the blocks/strips must exceed 1:1 to successfully co-exist with miners. Minimum dimensions of blocks need to be 12 ha (e.g. 300 m wide by 400 m long) while strips need to be 200 m wide.

Clearing has enabled populations of species of native birds adapted to open woodlands and forest-edges to enter and become dominant in the bushland. These include the Red Wattlebird, New Holland Honeyeater, White-plumed Honeyeater, Noisy Miner and Bell Miner. The honeyeaters and wattlebird have benefited from nearby garden plantations of grevilleas. The Red Wattlebird and Bell Miner are aggressive toward smaller birds during the Red Ironbark nectar flow. Their establishment in the Yarrambat ironbarks is a contributing cause to the decline of the medium-sized, forest-dependent nectivores such as the Regent and Yellow-tufted Honeyeaters and Little Friarbird.

Land and habitat degradation of PPOS in the upper Plenty Gorge. This is also discussed in the Plenty River Mernda site . The section of the site upstream of Yarrambat Park was visited on 19 March 1993. Severe land and habitat degradation has occurred in recent years. Land clearing around 1964 removed the box-stringybark woodland on the spur above the gully and above the downstream section of the river. Stock graze to the edge of the gully and river escarpments.

The trees, particularly Red Stringybark and Narrow-leaf Peppermint (but also Yellow Box and Manna Gums), are undergoing dieback. The lack of shrub regeneration and the death of many Red Stringybarks is also attributed to grazing, ringbarking and ground compaction by cattle. Red Stringybarks under stress are susceptible to the Cinnamon Fungus, which may have been brought in or spread by the earthworks. The earthworks did bring in Montpellier Broom. This weed is now over-running the area and will be difficult to control. Clearing the steep upper escarpments and gullies facilitated sheet and tunnel erosion and the establishment of large populations of rabbits in the 1960s and 1970s. Foxes live in the old rabbit warrens and wombat burrows and prey on the rabbits and native ground fauna. Pools in the gullies are turbid, polluted by paddock runoff and choked with Blackberries.

The next stage of revegetation should aim to provide structurally and floristically diverse stands to increase the number of niches for beneficial foliage insectivores. There is a threshold beyond which it becomes increasingly difficult for miners to drive out sufficient numbers of foliage insectivores without expending energy/resources needed to maintain a viable colony. At this stage the trees can start to recover and the dominance of the miner breaks down. If blocks share at least one contiguous boundary with forest the minimum area decreases.

Revegetating cleared or degraded discontinuities in external habitat links would provide greater connectivity to bushland in the Plenty Gorge. An overland revegetation program of box-stringybark woodland should be devised to link stands external to Plenty Gorge Park that have been isolated by housing and farms. Strips on farmland with a native-dominated field layer should be fenced and subjected to reduced grazing impact from livestock. Funding assistance should be provided for fencing and follow-up weed control and replanting.

A similar plan should be devised for re-establishing a viable habitat link encompassing the hill-slopes and escarpments along the river. This would require revegetating or replanting the streamway, a strip at least 100 m wide to each side of the break of slope (see Regional Hydrological Strategy in Volume 1). This should aim to raise the rate of faunal population exchanges within the site and to upstream and downstream sites of significance along the riparian corridor. Strengthening habitat links along the river would increase faunal values (e.g. habitat for Common Wombats).

In the 1920s Clements Gully contained mountain fauna including the Superb Lyrebird and probably the Yellow-bellied Glider. When first visited in the early 1970s, it was still a humid tree-fern gully. As well as the Rough Tree-fern (which still persists), the gully contained a few old Messmates, the Derwent Speedwell, copses of Victorian Christmas-bush and large stands of Sword Tussock-grass and Slender Tussock-grass. There was little Blackberry and the gully was the only known locality of the Spotted Brown butterfly, Bush Rat and Brown Antechinus in the Yarrambat site. It was also the only known locality of the Bright Copper butterfly in the Plenty Gorge. The gully has been opened up and dried out by land clearing, water deprivation due to catchment dams and livestock access. Severe land degradation and weed and vermin invasion resulted. The Messmate, Christmas-bush, speedwell, butterflies, Bush Rat and antechinus have been eliminated.

Integral with the Yarrambat site in the early 1970s, the section upstream of Yarrambat Park is now fragmented and fauna and flora values continue to diminish. The fragmentation and degradation has placed a limiting 'bottleneck' within the most significant biological node in NEM. Designated as PPOS, it may be some time before it is acquired into the park. Continuing land degradation and habitat fragmentation in this bottleneck will affect the integrity of the remainder of the site.

Decline of the Rainbow Bee-eater and other rare northern Australian migrants. The rolling chorus of the Dollarbirds, the 'four-o'clock' of the Noisy Friarbirds and the buzzing of the Rainbow Bee-eaters were the late spring signatures of the early 1970s along the upper section of the Yarrambat pool. The earlier land clearing near Clements Gully has almost certainly contributed to their decline over the last decade. The first two species are now 'vagrants'. The pool still has strong affinity for inland birds such as corellas and woodswallows.

Proposed Public Open Space. PPOS acquisition of key areas of habitat on private land is considered necessary to ensure management and function of habitat links (MPE 1990). There is great need to assist farmers who own PPOS with land protection activities to prevent the running down of flora and faunal values by the time the land is acquired into the park. Voluntary co-operation of landowners with regard to appropriate management of this land should be sought in the first instance. There appears to be widespread anxiety and future uncertainty expressed amongst landowners, regarding PPOS. Likewise, difficulties exist for Melbourne Parks & Waterways in areas it does not (yet) own regarding access, enforcement of appropriate planning controls (e.g. habitat clearance) and the conduct of effective management.

Regeneration of Yellow Box–Red Stringybark box–stringybark woodland on the spurs and cleared hill-slopes may stop the decline of these birds.

Bells Miners and eucalyptus dieback. Bell Miners were localised along the Plenty River at Yarrambat in the 1970s. Small colonies now occupy the entire riparian strip. Until the early 1990s, a large concentration (50 or more birds) occupied the lower section of Smugglers Gully. Many of the Swamp Gums, Yellow Box and Narrow-leaf Peppermints died due to defoliation induced by the Bell Miners and the colony moved upstream to Clements Gully (see above and volume 1)..

Declining nectar/flower production of Red Ironbarks. Similar to the Yellow Gums in the Plenty–Janefield site, the frequency of flowering and rate of flower production of Red Ironbarks has declined and the rate of insect leaf damage has increased at Yarrambat (see fauna section). The cycle of heavy flowering years over a 16-year study broadened from between five and six years to eight to ten years. The rate of nectar production by individual Red Ironbark flowers decreased by 50%. Populations of honeyeaters have consequently decreased.

Roads severing habitat links—road-killed mammals and reptiles. The road-kill rate of Eastern Grey Kangaroos, Common Wombats and Black Wallabies is increasing along the major roads. The lack of secluded internal habitat links along critical sections of the gorge (e.g. Kurrak Road bridge area) and external habitat links to neighbouring areas could isolate populations of these species in the gorge. The most important links cross Yan Yean Road to the east to connect suitable habitat in the Diamond Valley. Partial links also occur across Bridge Inn Road to the north which connects the Mernda to Yan Yean site, and Plenty Road in the west which connects the Quarry Hill site.

Protection of volcanic plains grasslands in the Plenty Gorge. The site contains one of few areas of volcanic plains grassland (while degraded and fragmented) occurring within a biological reserve in NEM. It is estimated that less than 1% of the original extent (i.e. 20 000 ha of an estimated 20 000 km²) of this habitat is intact on the Western Volcanic Plains of Victoria (Stuwe 1986). It is further estimated that only 1% of this (i.e. 200 ha) is contained and appropriately managed in a biological reserve. Grassland and grassy woodlands have by far the lowest original extent/reserved area ratio for any plant community in Victoria and are clearly the most threatened in the Victoria. The consolidation of intact stands upstream at Carome and Sirriani's in the Mernda site into the Plenty Gorge Park is considered essential for the conservation of genetic and ecological integrity of grassland habitats in Victoria.

Regional Hydrological Strategy

Declining instream fauna. Two relatively rare native freshwater crustacea (*Euastacus woiwuru* and *Engaeus quadrimanus*) were present at Yarrambat at the Eagle Point Rapids and upstream of the Yarrambat pool on Wilton Vale Farm in the mid-1970s. They were not recorded during the electrofishing survey of December 1988. Neither were recorded during an invertebrate survey upstream at Bridge Inn Road Mernda (Campbell *et al.* 1982). This is indicative of the decline in water quality of the stream over the last two decades. These crustacea are important dietary items of the Platypus. They are dependent on low water pollution and turbidity conditions and adequate native instream and riparian habitat.

Plenty River. Threatening processes arising from past, and the potential from future, land settlement are increasing. Improving the water quality upstream along the Plenty River (see the Darebin and Barber Creek, Plenty River Yan Yean and Glenvale Wetlands management units) would enhance the conservation significance of the Plenty Gorge section of the river for instream fauna.

There has been substantial degradation of fish habitats in the Plenty River, particularly in the Plenty Gorge (McKenzie & O'Connor 1989). Several species including the Southern Pygmy Perch, Mountain Galaxias and Australian Smelt would have been formerly present, but were not recorded during the electrofishing survey. Any further degradation of instream habitat and water quality will further reduce the distribution and abundance of native species which are present in low numbers and could threaten their survival (e.g. Common Galaxias). The river now contains critically low populations of Freshwater Blackfish. Continued angling is likely to eliminate them.

Poor water quality and declining native instream fauna. The water quality of the Plenty River at Yarrambat is relatively poor (Reed & Newall 1988). It contains few native fish and large populations of introduced fish species (McKenzie & O'Connor 1989). Invertebrate and water quality studies found the river to contain low oxygen and high levels of pesticides, herbicides and fertilisers (Campbell *et al.* 1982, EPA 1990).

In the early 1970s the Yarrambat pool was a popular swimming hole and fishing spot for blackfish. An environmental study of the Plenty River indicated that water quality levels, while containing some faecal contamination from septic tank leachates (at the time of the study the entire catchment was unsewered) and farmland runoff, was of satisfactory health standard (EPA 1990). The water quality has substantially declined over recent years. *E. coli* (a faecal bacterium) levels are now as much as 125 times acceptable public health standards (Melbourne Water 1991). Several drains emitting odorous/ discoloured water enter the river upstream at Mernda. Water conductivity and water quality increased markedly downstream of Mernda, possibly due to urban/industrial runoff and discharge.

There appear to be several causes of the decline in native fish (see volume 1). A major factor is increased water turbidity from poor land management practices such as clearing native vegetation from streamways and steep, erosion-prone hills, excessive streamway earthworks and trampling/grazing of stream banks by livestock. Water pollution and nutrient enrichment in stormwater runoff from Whittlesea and smaller townships such as Mernda and South Morang, phosphates and nitrates arising from livestock and human faeces (e.g. septic tank leachate and Cades Road sewage treatment plant discharge) and high application rates of superphosphate and pesticides on farmland are further factors in the deteriorating water quality (Reed & Newall 1988; McKenzie 1989). Licensed discharge of pollutants from industries around Mernda has affected water quality throughout the gorge. Dumped rubbish and debris blowing in and possible effluent leachate from the Gordons Road tip (now closed) were additional factors contributing to the poor water quality at Gordons Road and Kurrak Road.

Inadequate summer–autumn stream flow and declining native instream fauna. A major compounding factor in the native fish decline is the loss of adequate stream flow in summer–autumn to flush out the build-up of water contaminants. Up to 70% of the natural flow has been taken by Toorourrong–Yan Yean Reservoirs. Water is drawn from the river for farmland purposes throughout its middle reaches. The bulk of the summer flow is contaminated water. The loss of critical stream flow during the breeding season has probably eliminated several invertebrate species (e.g. stoneflies and freshwater crustacea) and vertebrate species (e.g. Lesueur’s Tree Frog and Broad-finned Galaxias).

Roach. The Southern Pygmy Perch and Mountain Galaxias were not recorded during the survey. On the basis of habitat and distribution elsewhere in NEM they may have occurred in the gorge. They may have been eliminated by the Roach which now inhabit the mildly polluted waters in large numbers. Relatively swift flowing waters such as in the Plenty Gorge are not readily utilised by Roach. They are present as the gorge also contains deeper, slackwater pools. Their eggs are tolerant of far higher levels of water pollution and sedimentation than most native species. They are a scavenging species with a broad diet of invertebrates and plants (Closs 1984). Roach are likely to compete with all native fish present either by competition for food and space or through predation of the smaller species and the fry and eggs of all species.

Many of the old, large farm dams in the Plenty Valley catchment which were part of large properties are not fully utilised on small farms and remain full over summer. There needs to be some water release from a network of the dams at critical low stream flow periods to flush out the stagnating pools. There needs to be a restriction on further proliferation of dams (especially large dams) on hobby farms. High land hazard areas of the catchment such as steep, eroded gullies in heavily cleared areas (e.g. Eden Park) should be identified and these should be targeted for land protection works such as fencing to enable stock exclusion and revegetation. The establishment of a hydrological strategy for the Plenty River is an urgent conservation issue in need of address within the City of Whittlesea.

Grazing effects on native flora, weeds and soil erosion. Gully erosion has resulted from the increased and more rapid runoff caused by tree clearing and overgrazing in the hill catchments between Doreen and Plenty. Rabbits have denuded sections of the exposed sedimentary escarpments of the river, particularly the skeletal soils supporting Yellow Gum and Yellow Box. This has caused sheet erosion. The resultant siltation of the river is a major cause for concern for the long-term viability of Platypus populations. Weeds and weed invasion adversely effect faunal conservation values by attrition of the available area of native understorey habitat. Rabbits affect the integrity of the flora within the site. Populations of Eastern Grey Kangaroos have increased to unsustainably high levels in the gorge. Large camps of kangaroos are present in the Yarrambat ironbarks. They are browsing and trampling the understorey vegetation and, along with rabbits, have substantially reduced orchid populations.

Monitoring and adherence to water quality guidelines in the Plenty River.

Other Issues

Feral and roaming domestic cats and dogs.

Increasing populations of introduced predators such as foxes and feral and domestic cats and dogs are a major problem for wildlife in the gorge. The precariously low populations of Black Wallabies and Common Wombats are now further threatened by hunting packs of domestic dogs that roam the gorge at night. Dumped or stray pets from nearby areas provide a continual source of many of these animals.

Increasing visitor rate disturbance to breeding birds. Several significant species of birds require protection from visitor disturbance while breeding. Most affected are the Black-winged Stilt, Wedge-tailed Eagle, Peregrine Falcon and Swamp Harrier.

Alien and native pest species controls. See Volume 1. These should address both livestock and companion animals. The focus should be the formulation of guidelines to reduce pest species populations. A systematic weed control program for Blackberry, Montpellier Broom, African Box-thorn, Chilean Needle-grass and other noxious and environmental weeds should be implemented. Effective control or elimination of introduced feral mammal predators and rabbits should be undertaken.

Volcanic plains grassland fauna captive breeding and release program—Morang Wetlands predator fence. The Morang Wetlands volcanics (Mother-In Law's Leap/North East Wetland) offer a potential reintroduction site for threatened plains animals including the Eastern Barred Bandicoot, Eastern Quoll, Striped Legless Lizard and Southern Lined Earless Dragon. Preparation would require systematic weed control, natural revegetation, species enrichment planting and the security of a predator fence. There appears to be heavy fox predation of nestling waterbirds. A predator fence around the entire Morang Wetlands needs to be seriously considered in order to sustain breeding waterbird populations (e.g. Black-winged Stilt).

It is essential that access is restricted from these areas during the breeding season. Other areas or activities that visitors need to be excluded from include cliffs, escarpments, quarries and mines (fragile to foot traffic; safety) and fishing in Blackfish/Platypus waters.

Morang Wetlands Development

For a detailed discussion of the Management Issues see Appendix 4.2.

Planning Recommendations

Red Ironbark–Yellow Gum Conservation Area. The most critical requirement is the designation of a Red Ironbark–Yellow Gum Conservation Area to consolidate all existing and potential box–ironbark woodland in the site under conservation management.

Yarrambat–Morang Wetlands Ecological Reference Area (ERA). The proposed ERA contains: the river and adjoining bushland from the junction of Smugglers Gully to the Yarrambat falls and includes the Morang Wetlands. Key biological/research areas of the ERA are the Yarrambat ironbarks, Smugglers Gully, the Plenty River and Morang Wetlands.

The ERA requires restricted public access conditions and nature conservation of all native habitat and potential native habitat to be the principal planning/land-use priority. The ERA encompasses land in the Plenty Gorge Park and PPOS and contains specific conservation and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). An ERA buffer zone is provided by Yarrambat Park. Management should be upgraded in the park to protect biological values in the ERA. Appropriate signs prohibiting unauthorised access will

be required along the eastern perimeter of the ERA with Yarrambat Park and other entry points along the river. The negotiation of conservation covenants or similar conservation agreements as to the management of adjacent freehold bushland (particularly PPOS) would be desirable.

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the ERA include:

- River spur, escarpment and cliff/Red Ironbark–Yellow Gum box–ironbark woodland (12.2) and Golden Wattle cliff/escarpment shrubland (20.4): honeyeater assemblage and Regent Honeyeater, Barking Owl, Powerful Owl, Brush-tailed Phascogale and Common Dunnart.
- River gorge, pools, terraces and rapids/Manna Gum floodplain riparian woodland (16.4/16.5) and Muttonwood riparian scrub (18.1): Regent Honeyeater, Rainbow Bee-eater, Platypus and Freshwater Blackfish.
- Quarrys/seasonal and permanent wetland (25.1, 25.7 and 26.1): waterfowl and waterplant assemblages and Blue-billed Duck.

Supportive categories in the ERA include:

Manna Gum gully woodland (10.1): nesting Wedge-tailed Eagle and reptile and migratory insectivorous bird assemblages. Yellow Box–Red Stringybark box–stringybark woodland (11.2): Ictinus Blue butterfly. Long-leaf Box–Manna Gum escarpment woodland (13.1): reptile and migratory insectivorous bird assemblages. River Red Gum grassy woodland (14.1), Yellow Box–Hill Manna Gum grassy woodland (14.2) and Lightwood–Tree Violet cliff/escarpment shrubland (20.5): volcanic plains herpetofauna assemblage.

Development and extension of the Plenty Gorge Park as outlined in the concept plan. The park is a vital link in the ‘green web’ initiative.

Site 41 Kurrak Road

- Map Reference:** 7922 325298 to 7922 330325 (Plenty River). One minute lat/long grids include 37° 38' x 145° 06' to 07' and 37° 39' x 145° 06'.
- Location/Size:** The Plenty Gorge from the north section of R&D Estate to upstream of Smugglers Gully, including Nioka scout camp. Approximately 200 ha.
- Municipality:** City of Whittlesea and Shire of Nillumbik (east of river).
- Land Tenure/Use:** Public: Plenty Gorge Park (Melbourne Parks & Waterways). Private: land to the east in the Shire of Nillumbik is proposed urban development (1 ha blocks) while farmlets in the site closer to the river is zoned Conservation 1. Bushblocks fronting the river are Proposed Public Open Space.
- Landforms:** Foothill and alluvial and volcanic plain (see PLH A). Elevation is 100–140 m.

Natural Heritage Values

Landscape. The Kurrak Road section of the gorge provides a high diversity of visual drama and physiographic contact points. Disturbance and habitat fragmentation from human settlement has had greater effect in this site than at the Plenty–Janefield and Yarrambat sites.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2; Government Rd); Golden Wattle cliff/escarpment shrubland (20.4; Charlesville Rd); Lightwood–Tree Violet cliff/escarpment shrubland (20.5; Riverland Estate)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Narrow-leaf Peppermint herb-rich foothill forest (6.2); Manna Gum gully woodland (10.1; Smugglers Gully); Red Box–Red Stringybark box–stringybark woodland (11.1; Stuchberry Hill); Long-leaf Box–Manna Gum escarpment woodland (13.1); Red Box escarpment woodland (13.3); Manna Gum floodplain riparian woodland–riverbank (16.4); Manna Gum (river terrace) floodplain riparian woodland (16.5); Muttonwood riparian scrub (18.1)

Vulnerable species: Wine-lip Spider-orchid

Rare species: Bearded Greenhood, Rye Beetle-grass, Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Cliff/Escarpment Critical Conservation Area and Strategic Habitat Link. Volcanic plain cliff/escarpment shrubland reference stand at Riverland Estate; high native species and regionally significant species diversity; cliff/escarpment flora of Riverland Estate and Charlesville Road

FAUNAL SIGNIFICANCE: Site 41 Kurrak Road

Assessment: State—Category 2 (B, C, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

41^a: 37° 38' x 145° 06'; Plenty Gorge Park–Purvis Gully to Smugglers Gully

41^b: 37° 38' x 145° 07'; upper Smugglers Gully/Ashley Road, Yarrambat

41^c: 37° 39' x 145° 06'; Plenty Gorge Park–Kurrak Road to River Avenue

A. Cited Zoological Significance

Regional. Beardsell (1989); Biosis (1991)

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. **41^a:** Ictinus Blue butterfly

c. Rare fauna

State. 41^a: Letter-winged Kite, Black Falcon, Masked Owl, Barking Owl, Powerful Owl, Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Unranked. 41^a: 22 species at the now infilled Gordons Road Quarry on 20 November 1987

d. Breeding waterfowl

Unranked. 41^a: 8 species at the now infilled Gordons Road Quarry on 20 November 1987

e. Honeyeaters

State. 41^a: 12 species in a 20 minute nectarfauna census at Charlesville Road Red Ironbarks on 21 June 1991

l. Reptiles

Regional. 41^a: 7 species amongst the basalt columns upstream of Kurrak Road at the rear of the Emmaus land on 16 December 1988

m. Freshwater fish

Local. 41^c: 2 species (Short-finned Eel and Flat-headed Gudgeon) electrofished at Kurrak Road on 15 December 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 41^a: over 140 species

b. Native birds

State. 41^a: over 110 species

c. Native mammals

Regional. 41^a: 15 species

d. Herpetofauna

Regional. 41^a: 16 species

e. Freshwater fish

Local. 41^c: 2 species. **41^a:** 1 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 41^a: 25 species

b. Regionally endangered fauna (R1 species)

Regional. 41^a: 3 species. **Birds:** Letter-winged Kite, Masked Owl. **Butterflies:** Ictinus Blue

c. Regionally vulnerable fauna (R2 species)

State. 41^a: 7 species. **Birds:** Barking Owl, Black Falcon, Hooded Robin, White-throated Gerygone, Fuscous Honeyeater. **Mammals:** Brush-tailed Phascogale. **Fish:** Flat-headed Gudgeon

Regional. 41^c: 4 species. **Birds:** Hooded Robin, Black-chinned Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater

d. Regionally rare fauna (R3 species)

Regional. 41^a: 3 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift, Pink Robin

e. Regionally depleted fauna (R4 species)

State. 41^a: 12 species. **Birds:** Powerful Owl, Whistling Kite, Peregrine Falcon, Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, Bassian Thrush, White-winged Triller, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink

Local. 41^c: 1 species (incidental records only in grid). **Fish:** Flat-headed Gudgeon

f. Regionally restricted fauna (R5 species)

Regional. 41^a: 17 species. **Birds:** Painted Button-quail, Brush Bronzewing, Great Egret, Nankeen Night Heron, Barn Owl, Little Eagle, Australian Hobby, Long-billed Corella, Brush Cuckoo, Rose Robin, Red-browed Treecreeper, White-winged Chough. **Reptiles:** Large Striped Skink, Cunningham's Skink, Tussock Skink, Little Whip Snake. **Mammals:** Water Rat

g. Nesting birds of prey

Regional. 41^a: Whistling Kite, Collared Sparrowhawk; former nesting Masked Owl

F. POPULATION DENSITY: Viability and Abundance—point census

c. Waterfowl

Unranked. 41^a: over 340 on the now infilled Gordons Road Quarry in April 1987; 142 on 20 November 1987

e. Honeyeaters

State. 41^c: over 300 in a 20 minute nectarfauna census at Charlesville Road Red Ironbarks on 21 June 1991

g. Rare/restricted colonial fauna

Regional. 41^a: Nankeen Night Herons bred in late spring/summer 1991 in the riparian scrub adjacent to a large pool about 300 m downstream of the Gordons Road ford

l. Regionally vulnerable fauna (R2 species)

Regional. 41^c: 30 Fuscous Honeyeaters at Charlesville Road Red Ironbarks on 21 June 1991

m. Regionally rare fauna (R3 species)

Unranked. 41^a: 40 Hardheads on the now infilled Gordons Road Quarry in April 1987

Outlook

The faunal significance is declining and may move from state to regional due to habitat fragmentation and degradation and weed and vermin invasion from housing development unless rehabilitation works are conducted and the objectives of the conservation 1 zone are met.

FAUNA

Rare or Threatened Fauna

Bb 41^a: Ictinus Blue at lower Purvis Gully. Adult observed in Red Box escarpment woodland (13.3), taking nectar from flowering Sweet Bursaria on 3 February 1994. Likely breeding colony in locality (see Plenty–Janefield site).

Bc 41^a: Letter-winged Kite. One was seen at Gordons Road on 31 July 1993 (Mark Tscharke pers. comm.). The species originates from inland Australia. The floods of 1990/91 in the Centre and subsequent rodent plagues enabled populations of the kite to build. A drought followed in 1992/93 and the surplus population began to disperse with some entering Victoria. They were reported in autumn 1993 in the Victorian Wimmera, where a mouse plague was occurring. As the mouse plague waned in winter 1993, the kites appeared on the coastal plains. The last major irruption into Victoria was in late 1976 and 1977 where a gathering of 70 birds occurred at Werribee Sewage Farm. When in Victoria, the kite inhabits lightly timbered plains country. They take prey in a similar fashion to the Black-shouldered Kite, by hovering overhead and dropping to the ground. The Letter-winged Kite usually hunts at night.

Bc 41^a: Black Falcon. One was seen in Manna Gum (terrace) floodplain riparian woodland (16.5) at Nioka scout camp in December 1991. This species is a rare visitor to the Plenty Gorge.

Bc 41^a: Barking Owl and Powerful Owl downstream of Purvis Gully. The former was heard in early May 1996 and the latter was seen in late February 1996 (Mark Tscharke pers. comm.). The habitat was Red Box escarpment woodland (13.3). Sugar Gliders, Common Ringtail Possums and rabbits are locally common and

would likely form the main prey of both owls. Two Barn Owls were also heard calling on 1 November 1996 (Mark Tscharke pers. comm.).

- Bc* **41^a: Masked Owl in lower Purvis Gully.** A single bird responded to a playback call on 19 October 1991 (Manna Gum gully woodland; 10.1). A pair nested in a small cave in cliffs nearby along the Plenty River in the late 1970s.
- Bc* **41^a: Brush-tailed Phascogale.** One seen while spotlighting in autumn 1995 above Nioka scout camp in Yellow Box–Red Stringybark box–stringybark woodland (11.2); (Mark Tscharke pers. comm.). One had been recorded in Red Box escarpment woodland (13.3) flanking Purvis Gully in 1977. The phascogale is apparently very rare in the Plenty Gorge due to severance of habitat links.

Critical Assemblages or Populations

- Fe* **41^c: High population density of honeyeaters in the Red Ironbarks at Charlesville Road.** Over 300 of 12 species (excluding miners and wattlebirds) were recorded in a 20-minute/2 ha census on 21 June 1991 of the Red Ironbark–Yellow Gum box–ironbark woodland (12.2) along the Charlesville Road spur. Species included the regionally vulnerable Black-chinned, Fuscous and Yellow-tufted Honeyeaters. This is an important section for these honeyeaters which are declining in Greater Melbourne. Assemblages of this richness and density are considered to be of state significance. Regent Honeyeaters may occasionally visit, particularly while moving along the river corridor from Yarrambat to the Yarra River.

Other Significant Fauna

Birds

- Ec* **41^a: Hooded Robin.** Recorded on 21 June 1991 in Red Ironbark–Yellow Gum box–ironbark woodland (12.2) along the Charlesville Road spur. Rare winter visitor to the Plenty Gorge.
- Ec* **41^a: White-throated Gerygone.** A pair observed in Narrow-leaf Peppermint herb-rich foothill forest (6.2) in Purvis Gully in late October 1991. Probably breeding.
- Ee* **41^a: Rainbow Bee-eater.** A pair was seen in Yellow Box–Red Stringybark box–stringybark woodland (11.2) on Lorikeet Track spur (north of Nioka scout camp) in late October 1991. During the 1970s, about 10 nesting colonies of Rainbow Bee-eaters encompassing perhaps 70 birds inhabited the Plenty Gorge between Lorikeet Track and the upstream end of Yarrambat pool. The main nesting area was above the cliffs on the northern side of Lorikeet Track. Over the last 15 years there has been a steady decline in the number of bee-eaters visiting the district. Fewer than 6 birds were seen between Lorikeet Track and the upstream end of Yarrambat pool between 1988 and 1993. None were recorded between 1994 and 1996. The reasons for the decline are unknown, but may be linked to a combination of changing environmental and habitat parameters and possibly river pollution affecting their semi-aquatic prey.
- 41^a: Nankeen Night Heron.** A pair apparently bred in late spring/summer 1991 in riparian scrub under Manna Gum (riverbank) floodplain riparian woodland (16.4) adjacent to a large pool about 300 m downstream of the Gordons Road ford (Mark Tscharke pers. comm.).
- 41^a: Herb-rich foothill forest and gully woodland avifauna of Purvis and Smugglers Gully.** Purvis and Smugglers Gully were visited on several occasions between 1986 and 1996. Red Stringybark herb-rich foothill forest (6.1) and Narrow-leaf Peppermint herb-rich foothill forest (6.2) occupy lower sheltered hill-slopes and escarpments while Manna Gum gully woodland (10.1) occurs in the gullies. Small stands of Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2) occupy sheltered cliffs while Red Box escarpment woodland (13.3) occurs on exposed escarpments. The areas supported a diverse assemblage of mountain forest avifauna. Species recorded included the Brush Bronzewing, Australian King-Parrot, Brush Cuckoo, Rufous Fantail, Pink Robin, Rose Robin, Bassian Thrush, Crescent Honeyeater and Red-browed Treecreeper (breeding population of about a dozen birds in Red Stringybark on the sheltered hill-slope of Smugglers Gully in October 1996).

Houses are spread above the escarpments. Sections of bushland were cleared in the 1960s/70s and the site became fragmented. Most of the above species have declined markedly in recent years. Ground and shrub layer

fauna species appear to be succumbing to increased habitat fragmentation and predation pressure from foxes and cats.

41^a: Recent bird extinctions. The populations of several species have declined throughout NEM over the last two decades. The major reasons being habitat fragmentation from land clearing, particularly for housing and associated weed and vermin invasion, particularly cat predation. The following species were observed in the Purvis and Smugglers Gully area between 1977 and 1986 but were not recorded during the survey period.

White-throated Nightjar (Red Box escarpment woodland on Griffiths; presumably the last pair in the gorge which ceased visiting by the late 1970s); Blue-winged Parrot (autumn passage migrant; seen in grassland between the scout camp entrance on Gordons Road and the amphitheatre); Olive Whistler (winter visitor to Purvis Gully and scrub along river); Spotted Quail-thrush (Griffiths; breeding resident in the 1970s; now an autumn-winter vagrant to the Plenty Gorge); Eastern Whipbird (Purvis Gully in the late 1970s; locally extinct); Brown Treecreeper (scout camp amphitheatre; the population was composed of three colonies, each of 5-6 birds in the 1970s; these declined to one colony by the early 1980s; extinct by 1987); Noisy Friarbird (a frequent, if not annual spring/summer visitor to the scout camp in the 1970s; now vagrant to the Plenty Gorge); and the Satin Bowerbird (last seen in late winter 1977, at Purvis Gully).

41^a: Waterfowl at the Gordons Road Quarry wetland. Autumn 1987 saw an irruption of several inland waterbirds including the Australian Pelican, Red-kneed Dotterel, Hardhead and Pink-eared Duck into the area. The following waterfowl were recorded on a visit to the Gordons Road Quarry wetland in April 1987: the Australian Pelican (6 birds), Eurasian Coot (70 birds), Hoary-headed Grebe (30 birds), Australasian Grebe (50 birds), Australian Wood Duck (40 birds), Musk Duck (20 birds), Blue-billed Duck (one pair), Hardhead (40 birds), Pink-eared Duck (one pair), Pacific Black Duck (50 birds), Chestnut Teal (10 birds), Grey Teal (30 birds) and Australian Shelduck (one bird). Nine of these species were breeding in November 1987.

The wetland was infilled between 1988 and 1991 for the City of Whittlesea tip. The Australasian Grebe, Eurasian Coot and Pacific Black Duck still occur in small numbers on the tip retardation ponds and the Australian Wood Duck is widespread at large dams in the site. The other species are no longer present in the site (present in the nearby Morang Wetlands). Two pair of Red-kneed Dotterels bred on the shoreline of the quarry in November 1987.

41^c: Regionally extinct birds of the 1920s and 1930s—Bush Stone-curlew, Grey-crowned Babbler and Superb Parrot. From an interview with Ern Ewert. The Bush Stone-curlew and Grey-crowned Babbler nested amongst Drooping Sheoke in the River Red Gum and Yellow Box–Hill Manna Gum grassy woodlands (14.1/14.2) between Government Road and South Morang. An extensive stand of sheoke was present until the 1930s, only scattered trees remain. The Superb Parrot nested in River Red Gums between Kurrak Road and South Morang.

41^a: Regionally extinct birds of the 1920s and 1930s—Superb Lyrebird and Satin Bowerbird. (From an interview with Ern Ewert.) The lyrebird inhabited Purvis Gully (and other damp gullies in the Plenty Gorge) until the 1930s. Their range in the gorge by then had become fragmented. Lyrebirds formerly inhabited the Plenty and Yarra River to within 15 km of Melbourne's CBD. They have undergone a substantial range contraction from the lowlands and foothills of NEM. Clearing of damp gully habitat and fragmentation of habitat links due to closer settlement and predation of incubating birds and young by foxes and cats and disturbance from dogs and humans are the major causes of the decline.

Late last century, flocks of Satin Bowerbirds (predominantly males) were reported visiting the district as they attacked ripened pome fruit and grapes (Kearland 1900). Birds dispersed during early autumn into the lowlands from their breeding grounds in the ranges. Widespread shooting and poisoning occurred. The species is quite tame while feeding and was frequently taken by domestic cats when in the vicinity of farmyard orchards. Bowerbirds were an annual winter visitor from the ranges in the 1920s (Ern Ewert pers. comm.) By the 1930s they had become rare in the Plenty Gorge and were restricted to dense gullies. Female birds only were seen in the 1970s. These remain solitary and visited later in the season than males, seldom causing damage in orchards. Satin Bowerbirds are now locally extinct.

Mammals

Ec **41^a: Long-nosed Bandicoot.** This species was recorded in Narrow-leaf Peppermint herb-rich foothill forest (6.2) at Purvis Gully in 1977 and is now presumed to be extinct in the Plenty Gorge due to habitat fragmentation and predation (foxes and cats). Trapping should be conducted to determine if the Brown Antechinus and Bush Rat which were also recorded in 1977, are still present.

41^c: Regionally extinct mammals last seen in the 1920s. Recorded from an interview with Ern Ewert. These include the Spot-tailed Quoll, Eastern Quoll and Eastern Barred Bandicoot which occurred in Lightwood–Tree Violet cliff/escarpment shrubland (10.3) near the columnar basalt pillars in the old escarpment quarry west of Kurrak Road bridge and River Red Gum grassy woodland (14.1) toward South Morang.

Freshwater fish

41^a: Electrofishing Survey: Plenty River–Plenty Gorge at Gordons Road ford

Map reference. 7922 325324. **Altitude.** 120 m. **Survey date.** 15 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum (riverbank) floodplain riparian woodland (16.4; fair condition). Frontage: Long-leaf Box–Manna Gum escarpment woodland (13.1; west side, poor condition); Red Box escarpment woodland (13.3; east side, fair condition)

Physical Features:

Pools

Substrate. Silt, willow roots and logs on sheet sandstone

Maximum size (mid-summer). 10.0 m wide by 2.0 m deep by 200 m long

Riffles

Substrate. Sandstone and basalt cobbles and gravel on sheet sandstone

Flow (mid-summer normal): Size. 2.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 12 ML/day

Water quality

Summer: Temperature. 26.5° C. **Conductivity.** 620 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Flat-headed Gudgeon (1); likely breeding resident

Alien species numbers/status. Roach (200); likely breeding resident

Other comments. A Platypus was present. Land tenure: Plenty Gorge Park and freehold bushland frontages zoned conservation or for park inclusion.

41^c: Electrofishing Survey: Plenty River–Plenty Gorge at Kurrak Road bridge

Map reference. 7922 327313. **Altitude.** 110 m. **Survey date.** 15 December 1988

Vegetation. Instream: submerged and emergent herbfield. Bank. Manna Gum (riverbank) floodplain riparian woodland (16.4; fair condition but with grassy and woody weeds). Frontage. Long-leaf Box–Manna Gum escarpment woodland (13.1; west side, poor condition); Red Box escarpment woodland (13.3; east side, fair condition)

Physical Features:

Pools

Substrate. Silt, willow roots and logs on sheet sandstone

Maximum size (mid-summer). 6 m wide by 2.0 m deep by 200 m long

Riffles

Substrate. Sandstone and basalt cobbles and pebbles, gravel and silt on sheet sandstone

Flow (mid-summer normal): Size. 2.0 m wide by 10 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 19.0 ML/day

Water quality

Summer: Temperature. 22° C. **Conductivity.** 680 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (8); migratory sub-adult. Flat-headed Gudgeon (2); likely breeding resident

Alien species numbers/status. Goldfish (2); likely breeding resident. Roach (500); likely breeding resident

Other comments. Freshwater Blackish were present in the 1970s (Gerry Closs pers. comm.). Land tenure: Plenty Gorge Park, Kurrak Road bushland reserve and adjacent freehold bushland zoned conservation or for inclusion into the park.

MANAGEMENT

Threatening Processes	Conservation Measures
See the Yarrambat–Morang Wetlands and Plenty–Janefield sites.	

Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. Intact streamway habitat link upstream to the Yarrambat–Morang Wetlands site and downstream to the Plenty–Janefield site. These two sites are of national significance.

Habitat loss and fragmentation. Aerial photographs show that the bushland in this section of the gorge has been more heavily cleared over recent decades for houses and farmlets than the Yarrambat section. This has led to habitat loss, fragmentation, degradation and species extinctions in the Kurrak Road site. The grassy woodland on the South Morang side of the river have been severely fragmented by agricultural clearing and housing development. The Riverview Estate south of Kurrak Road has fragmented some of the most intact stands of Yellow Box–Red Stringybark box–stringybark woodland (11.2) and Yellow Box–Hill Manna Gum grassy woodland (14.2) in the Plenty Gorge. The understorey and many of the trees have been eliminated. Only small stands of both remain in the site (downstream near Government Road and upstream at Nioka scout camp).

Linkage and prevention of further fragmentation of streamway habitat along the Plenty River. The vital role the site provides as a habitat link would require that it be protected. Revegetation of strategic areas of farmland to provide a fuller link is a high priority. Bushblocks within the site of significance containing substantially intact ground flora should be protected from livestock grazing. Several important threatened or disjunct habitat stands occur in the site, some of which are amongst the most intact and extensive of their type in a biological reserve in NEM. These are Yellow Box–Hill Manna Gum grassy woodland (14.2) and cliff/escarpment shrublands (20.2, 20.4 and 20.5) at Riverview/Charlesville Road and Manna Gum (riverbank) floodplain riparian woodland (16.4) throughout.

The most significant riparian vegetation occurs where extensive frontage stands of Long-leaf Box–Manna Gum escarpment woodland (13.1; Riverview Estate), Red Box escarpment woodland (13.3; downstream of Purvis Gully) and Manna Gum (terrace) floodplain riparian woodland (16.5; Riverview Estate and Nioka scout camp) are present. The site performs a crucial role in the movement of fauna from Yarrambat to Janefield.

Protection and management of the Red Ironbark–Yellow Gum box–ironbark woodland of Charlesville Road. The stand was visited only once and was found to provide one of the most important feeding areas for honeyeaters in NEM. It may be a key site in the regional habitat link requirements of these species and particularly, the Regent Honeyeater.

Require wider buffer strips between housing and gorge. On conservation and fire safety grounds and in accordance with the requirements of the Regional Habitat Link and Hydrological Strategies any future development near the river needs to contain a strip between housing and the break of the escarpment slope of **at least 100 m**. Buffer strips containing native vegetation and outcropping rock must be protected during housing estate preparations.

Motor traffic speed restrictions. Speed limits (to say 75 km/hr) to combat the increasing rate of road-killed wildlife should be introduced where habitat links cross sections of roads. Crossing points of particular importance for mammals, reptiles and birds occur between the Kurrak Road bridge and the sweeping bend at Westgarth Street. To the east of the site a vital link into the Diamond Creek catchment occurs along Yan Yean Road between Browns Lane Plenty and Worns Lane Yarrambat. Elsewhere within the unit mammal crossing points occur along Bridge Inn Road between Doreen and Mernda and in the Wilton Vale Road to Hunters Lane section of Plenty Road.

 Regional Hydrological Strategy

Electrofishing site—Gordons Road ford. Litter and urban refuse was present. Some had washed down from the upstream Gordons Road tip but some had been thrown into the river from the ford. The water temperature was the highest recorded for the stream. Household grey waste water drains containing polluted water and septic tank leachates enter the river downstream of the ford. Rain causes turbid runoff from Gordons Road.

Electrofishing site—Kurrak Road bridge. Roach populations steadily climb in lower sections of the gorge due to nutrient enrichment. This section is a high-use picnic and fishing area. The banks have undergone significant damage from trampling. Litter was present. The land has been cleared on the western terrace.

 Other Issues

Restricted public access. Public access is gained at Kurrak Road and Gordons Road. River access elsewhere is poor and the escarpments in these sections are particularly sensitive to human disturbance.

Public access to the Gordons Road ford area (private river crossing) should be monitored as rubbish dumping has occurred. The sections away from Kurrak Road should remain restricted to public access.

Planning Recommendations

Yarrambat–Morang Wetlands Ecological Reference Area (ERA). Smugglers Gully and the sheltered hill-slopes and escarpments on the north side are contained in the proposed ERA (see site 40, planning recommendations).

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the ERA include:

- Sheltered hill-slope and escarpment/Red Stringybark herb-rich foothill forest (6.1), Narrow-leaf Peppermint herb-rich foothill forest (6.2) and Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2): mountain bird and diverse/rare orchid assemblages.
- Gully/Manna Gum gully woodland (10.1): rare ferns and gully flora.

Site 42 Plenty–Janefield

- Map Reference:** 7922 325270 to 7922 325298 (Plenty River); 7922 318286 (mid-point of the Ecological Reference Area); 7922 312290 (Blue Lake); 7922 317292 (Dry Quarry). One minute lat/long grids include 37° 39' x 145° 05', 37° 40' x 145° 05' to 145° 06' and 37° 41' x 145° 05'.
- Location/Size:** Approximately 370 ha.
- Municipality:** City of Whittlesea and Shire of Nillumbik.
- Land Tenure/Use:** Public: Proposed Public Open Space and Plenty Gorge Park (Melbourne Parks & Waterways); Janefield Training Centre (CSV and an area reserved for cemetery purposes (Urban Land Authority). The latter is undergoing a capability assessment for housing. Private: bushland in the Shire of Nillumbik near the river generally zoned Conservation 1 (containing PPOS); farmland backing the Conservation Zone is proposed for urban development.
- Landforms:** Foothill and alluvial and volcanic plain (see PLH A). Elevation is 50–150 m.

Natural Heritage Values

Landscape. The most diverse assemblage of landform and geological types and broadest overlap of biophysical types in GM. The gorge has considerable natural heritage and landscape values. It supports the only intact representative of the Hill Manna Gum Tertiary volcanic/river alluvium and Yellow Gum/sandstone landforms remaining in NEM. The river sections contain the most spectacular terrain and visual drama in the urban area of NEM. The Plenty Gorge forms the most significant bushland in Metropolitan Melbourne and provides the only point of contact for many flora and fauna species with the urban area.

Scientific and Educational Values

Invertebrates–Dayflying Moths (Agaristidae). The Whistling Moth (*Hecatesia fenestrata*) was observed in the proposed Ecological Reference Area at Janefield and north of Dry Quarry. Larvae feed on Coarse Dodder Laurel. On both occasions, the dodder laurel also supported larvae of the Common Dusky Blue butterfly. Male Whistling Moths emit an audible whistle as they fly. The upper surface of the forewings have warty knobs which are apparently voluntarily struck together causing a membranous, crescent-shaped fold to flex and make a series of rapid clicks resembling a whistle (CSIRO 1991). A large agaristid seen was *Comocrus behri*. The larvae feed on the locally common Box Mistletoe, also utilised by the Imperial White butterfly.

Scientific reference—Swift Parrot—Yellow Gum. Nectarfauna census plot in the Goldworthy Lane Yellow Gums. Swift Parrot populations and Yellow Gum flowering and nectar production were monitored for 16 years (1977–1992) at Goldworthy Lane. These studies determined the Yellow Gums to be one of the most important feeding grounds for Swift Parrots in GM. An Ecological Reference Area is proposed (see conservation measures and planning recommendations).

Public interpretation. The Blue Lake Environmental Education Centre in the Ecological Reference Area offers high potential for public appreciation and education of flora and fauna values. Usage must be carefully controlled because of likely impact on the fauna (particularly butterflies) and the sensitive and dangerous nature of the river and quarry escarpments.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Swamp Gum gully woodland (10.3); Yellow Gum–Red Box box–ironbark woodland (12.3); Long-leaf Box–Manna Gum escarpment woodland (13.1); Yellow Box escarpment woodland (13.2); Red Box escarpment woodland (13.3); River Red Gum (volcanic plain) grassy woodland (14.1); Hill Manna Gum sand-plain woodland (15.1); Burgan sand-plain woodland (15.2); Manna Gum (terrace) floodplain riparian woodland

(16.5); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2); Tall Sedge–Soft-Bog-sedge seasonal wetland (25.4)

Relatively intact and extensive stands: Manna Gum gully woodland (10.1); Muttonwood riparian scrub (18.1); Golden Wattle cliff/escarpment shrubland (20.4); Lightwood–Tree Violet cliff/escarpment shrubland (20.5)

Endangered species: Charming Spider-orchid

Vulnerable species: Matted Flax-lily, Clover Glycine (most extensive population in GM)

Rare species: Variable Nardoo, Grampians Greenhood, Emerald Greenhood, Bear's-ears, Slender Tick-trefoil

Critical assemblages or populations: Plenty–Janefield Ecological Reference Area and Strategic Habitat Link.

The most significant vegetation in NEM as evidenced by the high diversity of reference stands; those of National significance include Yellow Gum–Red Box box–ironbark woodland and Yellow Box escarpment woodland; sole reference stands in NEM of River Red Gum (volcanic plain) grassy woodland, Hill Manna Gum/Burgan sandplain woodland and Tall Sedge–Soft Bog-sedge seasonal wetland; biogeographic overlap of inland (goldfield) and coastal assemblages; rare or threatened butterfly and orchid assemblages; second highest diversity in GM of VROT (8 species) and highest diversity of regionally threatened, rare or depleted species (over 120 species)

FAUNAL SIGNIFICANCE: Site 42 Plenty–Janefield

Assessment: National—Category 3 (B); State (B, C, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

42^a: 37° 39' x 145° 05'; Plenty Gorge Park—R&D Estate and River Avenue

42^b: 37° 40' x 145° 05'; Plenty Gorge Park—Plenty/Janefield ERA

A. Cited Zoological Significance

Regional. Beardsell (1989); Biosis (1991)

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 42^b: breeding observation of the *Icilius* Blue butterfly (endangered in Victoria/secure in Australia).
Unranked. 42^b: Regent Honeyeater in 1977

b. Vulnerable fauna

National. 42^b: Swift Parrot (repeated observations) and Genoveva Azure, Large Ant-blue and *Ictinus* Blue butterflies (latter two breeding): only 1' grid known to support four vulnerable species in GM

c. Rare fauna

State. 42^b: Grey Goshawk, Barking Owl, Powerful Owl, Painted Honeyeater (breeding), Brush-tailed Phascogale, Common Bent-wing Bat and Rare White-spot Skipper and Fiery Jewel butterflies (both breeding)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 42^b: 10 species including the Rainbow Bee-eater, Satin Flycatcher and White-winged Triller at Janefield south spur on 14 January 1987

g. Breeding parrots

Regional. 42^b: 5 species at Janefield south spur on 14/15 January 1987

h. Bats

Regional. 42^b: 5 species at Janefield south spur on 16 January 1987

k. Frogs

Regional. 42^b: 8 species between Janefield Spur and Blue Lake on 25 March 1992

l. Reptiles

State. 42^b: 14 species including the Little Whip Snake and Red-bellied Black Snake from a 3-hour census between Janefield Spur and Dry Quarry on 25 March 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 42^b: over 150 species

b. Native birds

State. 42^b: over 110 species

c. Native mammals

Regional. 42^b: 18 species

d. Herpetofauna

State. 42^b: 27 species

e. Freshwater fish

Local. 42^b: 2 native species (Short-finned Eel and Flat-headed Gudgeon)

f. Butterflies

State. 42^b: 40 species (highest recorded in NEM)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 42^b: 51 species

b. Regionally endangered fauna (R1 species)

State. 42^b: 11 species. **Birds:** Grey Goshawk, Budgerigar, Western Gerygone, Painted Honeyeater. **Butterflies:** Rare White-spot Skipper, Genoveva Azure, Large Ant-blue, Fiery Jewel, Ictinus Blue, Icilius Blue, Miskin's Blue

c. Regionally vulnerable fauna (R2 species)

State. 42^b: 14 species. **Birds:** Crested Pigeon, Barking Owl, Azure Kingfisher, Black-eared Cuckoo, Red-capped Robin, Cicadabird, Brown Treecreeper, Black-chinned Honeyeater, Fuscous Honeyeater. **Mammals:** Fat-tailed Dunnart, Long-nosed Bandicoot (present in 1987 and probably locally extinct), Common Bent-wing Bat. **Fish:** Flat-headed Gudgeon. **Butterflies:** Dinky Dart

d. Regionally rare fauna (R3 species)

State. 42^b: 8 species. **Birds:** Darter, Collared Sparrowhawk, Little Corella, Fork-tailed Swift, Pink Robin. **Reptiles:** Marbled Gecko, Eastern Small-eyed Snake. **Butterflies:** Fringed Blue

e. Regionally depleted fauna (R4 species)

State. 42^b: 18 species. **Birds:** Whistling Kite, Peregrine Falcon, Powerful Owl, Swift Parrot, Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, Bassian Thrush, White-winged Triller, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink, Red-bellied Black Snake. **Frogs:** Bibron's Toadlet. **Butterflies:** Spotted Brown, Small Copper, Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 42^b: 34 species. **Birds:** Painted Button-quail, Australian Pelican, Great Egret, Cattle Egret, Nankeen Night Heron, Australian Shelduck, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brush Cuckoo, Rose Robin, Olive Whistler, Brown Songlark, Spiny-cheeked Honeyeater, White-winged Chough. **Reptiles:** Common Long-necked Tortoise, Large Striped Skink, Cunningham's Skink, Bougainville's Skink, Tussock Skink, Little Whip Snake. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure, Chequered Blue

g. Nesting birds of prey/parrots

Regional. 42^b: Barking Owl: Manna Gum hollow near Janefield Mine. Little Lorikeet: Yellow Gum hollow on Goldsworthy Lane

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 42^b: 90 Swift Parrots from a 2-hour count in the Plenty/Janefield Yellow Gum area on 12 July 1990; substantial breeding population (50–100) of the Ictinus Blue butterfly in February 1993 on Janefield spur

e. Honeyeaters/lorikeets

State. 42^b: 250 Musk, Little and Purple-crowned Lorikeets from 2-hour count in the Plenty/Janefield Yellow Gum area on 22 July 1986

g. Rare/restricted colonial fauna

Regional. 42^b: Common Bent-wing Bats at Janefield Mine

h. Other fauna

Local. 42^b: 10 Sugar Gliders in 1 hour spotlighting on 16 January 1987 at Janefield south spur

i. Regionally vulnerable fauna (R2 species)

Regional. 42^b: 6 Brown Treecreepers at Janefield south spur on 16 January 1987

m. Regionally rare fauna (R3 species)

Regional. 42^b: 5 Flat-headed Gudgeon electrofished at R&D—pipetrack rapids on 15 December 1988

n. Regionally depleted fauna (R4 species)

Regional. 42^b: 10 Rainbow Bee-eaters at Janefield south spur on 16 January 1987

Outlook

The site requires minimal human disturbance, ongoing conservation management programs (e.g. weed control) in accordance with the requirements of the Ecological Reference Area and the construction of a predator fence from residential areas to maintain faunal values. While most offstream faunal values are of state significance, most of the instream values are local to low regional significance. This underlines the effects on the river of advancing residential development and upstream water off-take and poor rural catchment management.

FAUNA

Rare or Threatened Fauna

Ba 42^b: Icilius Blue butterfly. A final instar larva commencing to pupate was located on 14 March 1994 on the stem of a low Black Wattle in Hill Manna Gum sand-plain woodland (15.1). The larva was being attended by small ants (possibly *Iridomyrmex itinerans*). A search in nearby Yellow Gum box–ironbark woodland (12.3) revealed a single pupa attached to a fallen leaf amongst litter at the base of a low Golden Wattle (presumably also a larval food-plant).

The Melbourne area appears to form the cool temperature limit of this inland butterfly and populations may be biogeographical relicts. The *Icilius* Blue possibly entered from northern Victoria through the Kilmore Gap during a warm and arid climatic phase toward the end of the Holocene Epoch (6000 to 7000 years ago). In southern Victoria the butterfly may have a similar life cycle to that of the *Ictinus* Blue. In favourable years it would probably undergo two flight seasons (late December to early February and early March to early April). An earlier flight season (November) is reported from drier regions of Australia. The *Icilius* Blue had been collected in southern Victoria from Eltham around 1940 and near Gisborne in 1902 (Michael Braby pers. comm.). The latter was secured by George Lyell, possibly from the southern Pyrete Ranges, where extensive stands of box–ironbark and box–stringybark woodland occur.

The *Icilius* Blue is listed as endangered in Victoria and secure in Australia (Douglas 1995). It has been recorded historically from fewer than ten localities with confirmed sightings in recent decades from only about five localities between the Little Desert and Broadford. All populations are highly localised. The *Icilius* Blue shares habitat and range with the *Genoveva* Azure and has undergone a similar decline due to agricultural clearing. The food-plants and attendant ant are widespread and abundant throughout the Plenty Gorge, but the butterfly appears very rare and localised. Adults have not yet been observed. They are smaller than other species

of *Jalmenus*, usually stay close to their breeding sites and do not hill-top. This and their apparent rarity makes them hard to locate. Like the Ictinus Blue, breeding colonies appear to transient in place and time.

Bb 42^b: Swift Parrot. See Critical Assemblages or Populations.

Bb 42^b: Genoveva Azure butterfly. A female was seen on 21 December 1990, investigating Box Mistletoe in Yellow Gum–Red Box box–ironbark woodland (12.3). A male was seen in the same locality during the butterfly surveys on 24 January 1994. This was hill-topping a Yellow Gum on a spur adjacent to the gorge. The Genoveva Azure is predominantly an inland species. It has become very rare at the periphery of its range in southern Victoria where it is known only from the Grampians and the low rainfall foothills to the north and west of Melbourne (see also site 103). The distribution in southern Victoria is restricted to the low rainfall box–ironbark and stringybark woodlands of the lowland plains and hills (supporting Yellow Box, Grey Box, Yellow Gum and Box Mistletoe) between Warrandyte and Bacchus Marsh. This area is now heavily settled and cleared. It adjoins a known biogeographic corridor for inland fauna through the Kilmore Gap in the Great Dividing Range.

The presumed breeding colony is yet to be located at Plenty–Janefield. A systematic search for the colony should be undertaken. The butterfly larvae feed on the leaves and flower buds of Box Mistletoe. In the lowland hills of NEM the mistletoe flowers in late summer-autumn and is hosted mainly by Yellow Box, Red Box, Yellow Gum and Red Ironbark. The butterfly larvae are attended by a Sugar Ant (*Camponotus* sp.). Substantial colonies of the Sugar Ant are present at the base of Yellow Gums containing the mistletoe in the vicinity of the adult sightings at Plenty–Janefield.

The butterfly larvae live in an apparently obligate relationship with the ant. Young larvae shelter during the day under bark near the mistletoe. As they grow they tend to shelter in the ant nests in stumps at the base of the feed-tree or occasionally in a hollow limb or under a log or stone. At night the workers closely tend the butterfly larvae amongst the mistletoe and feed on honeydew secreted from dorsal and lateral organs in the rear of the abdomen. The butterfly larvae have appear to show a preference for low clumps of mistletoe. When colonies are of a substantial size the mistletoe can become defoliated (leaves typically chewed around the margins) toward the end of the season (Nigel Quick pers. comm.).

The Genoveva Azure is listed as vulnerable in Victoria (Douglas 1995). It was recorded historically from about 20 localities and over recent decades appears to have been eliminated from over a quarter of these (e.g. Bacchus Marsh and Warrandyte). There is inadequate reservation of populations and their box–ironbark woodland habitats. Many are contained in refugias along roadsides and stream frontages, often amongst advancing settlement or intensifying farmland. These are threatened by further loss or degradation of understorey habitat and tree decline. Individual colonies appear highly localised and have been known to persist on a particular feed-tree for decades. This makes them highly vulnerable to clearing and collecting. The few colonies in biological reserves such as the Plenty Gorge need utmost protection.

Bb 42^b: Large Ant-blue butterfly. A large colony of the attendant ant (for discussion see the Fiery Jewel; *Bc*) is present in Yellow Gum–Red Box box–ironbark woodland (12.3). Between 1400 and 1600 hours on 27 November 1993, two male Large Ant-blues were observed adjacent to the ant colony. They were hill-topping in the canopy of a Yellow Gum on a narrow spur above the escarpment of the gorge. The ant-blue was recorded at two other localities in NEM during 1993/94. These were near Pound Bend (site 57) and Mt Beggary in Kinglake NP (site 103). It was also recorded in two other sites in 1988/89 by Michael Braby and Fabian Douglas. These were Eltham (site 49) and North Warrandyte (site 59).

The ecology of the species is poorly known. Pupae of related species have been recorded in ant-nests and it is believed that the ant-blue butterfly larvae may predate (by ingesting body fluids) on ant larvae (Douglas & Braby 1992). Adult Large Ant-blues fly from early November to early March, but generally occur in or above the tree canopy, and are difficult to detect. Almost all observations of this butterfly in Victoria have been of hill-topping adults, generally males. For further discussion see site 103.

The Large Ant-blue is listed as vulnerable in Victoria (Douglas 1995). Sightings over the last decade have been mainly confined to central Victoria (Kangaroo Ground/North Warrandyte, Eltham and Mt Beggary in NEM, the You Yangs in WM, and near Mansfield and Broadford; Douglas and Braby 1992).

Bb 42^b: Ictinus Blue butterfly. A colony of 50-100 larvae, pupae and adults was located on 13 February 1993 in Hill Manna Gum sand-plain woodland (15.1). The range of the species stretches from Melbourne, through the Kilmore Gap into north-eastern Victoria and the western slopes of the Great Dividing Range in NSW, to the central Queensland coast. It has declined near the southern end of this range. The Plenty Gorge and near Cottles Bridge represent the only remaining southern Victorian localities known to support the butterfly. There are two flight seasons near Melbourne (late December to late January and early March to early April).

The larvae at Plenty–Janefield feed on small to medium-sized Black Wattles. The larvae and pupae are closely attended by the Meat Ant (*Iridomyrmex* sp. *purpureus* group). Pupal cases are usually quickly dismantled by the ants, making the species more difficult to locate than the Common Imperial Blue, whose discarded pupal cases stack up for years.

The location of populations of the Ictinus Blue in the Plenty Gorge needs to be withheld as one of the factors thought to have led to the decline of the species elsewhere is over-collection. Restricted access to humans through the establishment of the proposed Ecological Reference Area at Plenty–Janefield would provide the necessary security for the population.

The population is being closely monitored. It underwent a substantial decline in the flight seasons of 1994–96. This is not uncommon for the species at the periphery of its range in southern Victoria. There appear to be several causal factors. Larvae have been observed falling prey to European Wasps, populations of which outbreak in late summer and autumn in mild conditions such as 1993. Larvae are also heavily parasitised by a Braconid wasp. The Meat Ant nests are being dug up by Echidnas and many have been abandoned. Areas near the feed-trees have become overgrown with grass. The Meat Ant requires open areas exposed to full sunlight. The larvae require early succession wattles (preferably 2–3 m tall). The trees are beginning to senesce. A leaf beetle plague in 1994 killed most of the small wattles in the vicinity of the colony.

If population recovery of the butterfly does not occur, a management program to expand the population will be necessary. Ictinus Blues have also been observed elsewhere in the Plenty Gorge on a spur at Yarrambat Park (site 40) in February 1993 and at lower Purvis Gully (site 41) in February 1994.

The Ictinus Blue is proposed as vulnerable in Victoria (Fabian Douglas pers. comm.). It has been recorded historically from about 15 localities and over recent decades appears to have been eliminated from perhaps a third of these (e.g. Sunbury, Bacchus Marsh, You Yangs). Few populations are reserved and most are threatened on farmland or road and freehold creek frontages.

Bc 42^b: Grey Goshawk. The goshawk was seen along the river at Janefield in autumn 1986 (Anthea Fleming pers. comm.). This was the only sighting in the Plenty Gorge. It was probably a dispersing bird from breeding areas in the ranges. They were once resident in the gorge (Batey 1910).

Bc 42^b: Barking Owl. They were recorded breeding on 10 October 1992 just downstream of Janefield Mine, in a Manna Gum trunk hollow along the river (floodplain riparian woodland; 16.4). The breeding range would encompass the entire Janefield Spur/Satyrinid Gully block (about 100 ha). The home range is much larger (about 1000 ha) and is used for foraging outside the breeding season and at times of food shortage. They are mobile within the home range from year to year as prey abundance fluctuates. This takes in the whole of the Janefield and Blue Lake land and the remnant River Red Gum plains woodlands to the west, now forming urban Blossom Park and Mill Park. Barking Owls usually rotate between alternate nest sites over a three to five year period. This enables recovery of prey populations such as Sugar Gliders.

Barking Owls were recorded at the north end of Mill Park as recently as 1989 (Alan Webster pers. comm.). Since that time linking woodlands have been substantially severed by housing. They apparently seldom urban woodlands as suitable prey species (e.g. Sugar Gliders and rabbits) are scarce. The loss of River Red Gum grassy woodland (14.1/14.3) in the residential area of Blossom Park and Mill Park will likely cause the Plenty–Janefield birds to rely more heavily on the Yellow Gum box–ironbark woodland (12.3), Yellow Box escarpment woodland (13.2) and Hill Manna Gum sand-plain woodland (15.1) on the east side of the river. These habitats presently form secluded and productive feeding grounds. They now provide critical foraging habitat and must remain intact. Straying cats from new development will likely reduce the Sugar Glider and rabbit population. This may threaten the long-term viability of the Plenty–Janefield Barking Owls.

Bc **42^b: Powerful Owl.** Single bird nesting in Muttonwood riparian scrub (18.1) along Plenty River at Blue Lake in March–April 1997 (Mark Tscharke pers. comm.).

Bc **42^b: Painted Honeyeater.** A breeding pair of Painted Honeyeater with two young was seen in Yellow Gum–Red Box box–ironbark woodland (12.3) at Memorial Drive spur on 21 December 1990. A statewide decline in populations (similar to the Regent Honeyeater) has occurred in recent decades due to clearing and fragmentation of box–ironbark woodlands (Emison *et al.* 1987). Areas of box–ironbark woodland in the site utilised by Swift Parrots and Painted Honeyeaters have been incorporated into the proposed Plenty–Janefield Ecological Reference Area.

The Painted Honeyeater was, until the late 1970s, a more frequent visitor to the Yellow Gums in the Goldsworthy Lane/Memorial Drive spur area. Several pairs nested in the area in the 1970s. The honeyeater has been observed only once in the last decade. Large, senescent trees heavily infested with Drooping Mistletoe where the honeyeater formerly nested elsewhere in NEM have died or been cleared over the last two decades. The fruit of the mistletoe provides food and the tangle of branchlets provides nesting sites. Stand fragmentation from clearing and residential encroachment in surrounding areas has enabled a population expansion of the highly competitive Noisy Miner and Bell Miner.

Bc **42^b: Brush-tailed Phascogale.** A dead animal was found near the Bell Miner census plot in the mid-1980s (Mike Clarke pers. comm.). The phascogale potentially utilises most habitats in the Plenty Gorge. One of the preferred habitats occurs adjacent to the plot on Janefield south spur (Yellow Box–Red Stringybark box–stringybark woodland; 11.2).

Bc **42^b: Common Bent-wing Bat at Janefield Gold Mine.** Two Common Bent-wing Bats were located in the mine on 24 June 1992. Only the external section was entered due to deep water being present. The mine may contain a substantial colony as several areas of droppings were present near the entrance. Human disturbance was evident (see conservation measures). The roosting substrate and climatic conditions offered appear ideal for cave-bats. Due to the presence of water and little air movement there are pockets of both warm, humid air and cold air. These conditions suit bent-wing bats and possibly the Large-footed Myotis. This bat was recorded along the river at Yarrambat where it probably roosts in water-filled mine shafts. The extent of the population of bent-wing bats in the mine needs to be assessed.

Bc **42^b: Rare White-spot Skipper butterfly.** Several adult males were seen in a section of open grassland under Yellow Gum–Red Box box–ironbark woodland (12.3) on 9 November 1993. The understorey supported copses of regenerating eucalypts, Burgan, Hedge Wattle, Black Wattle, Golden Wattle, Dogwood and Sweet Bursaria and native field layer dominated by Kangaroo Grass. The Small-flower Mat-rush and Wattle Mat-rush (suspected larval food-plants) were locally common. The butterflies were feeding on nectar from the Common Rice-flower. Other potential nectar plants include the introduced Cape Weed and Cat’s Ear.

The only other recent record in NEM was on a roadside at Nutfield in late October 1988 (Nigel Quick pers. comm.). The roadside verge of Yellow Box–Red Stringybark box–stringybark woodland (11.2) fronted open farmland and contained a similar, grassy understorey to where the species was seen in the Plenty Gorge. The skipper has not been relocated at Nutfield in recent searches. The Rare White-spot Skipper was recorded at Eltham and near Heathmont in the mid-1940s (Michael Braby pers. comm.; Nigel Quick pers. comm.) and at Research in the mid-1960s (Fabian Douglas pers. comm.). It appears to have been eliminated by development from each of these localities.

The Rare White-spot Skipper is proposed as insufficiently known in Victoria: recorded historically from about 12 localities in the rural/settled lowlands of Victoria and over recent decades appears to have been eliminated from perhaps a third of these (e.g. Research/Eltham and Heathmont). There are few recent records in Victoria. This may be due to a combination of rarity (or at least localised distribution), brief adult life cycle (four weeks from late October and two weeks in the second half of March), relatively small size and inconspicuous behaviour (flies low and fast amongst field layer vegetation) and an apparent preference for open habitats (including treed farmland) which are not often searched (Michael Braby pers. comm.; Nigel Quick pers. comm.). Similar to the Genoveva Azure, few populations are reserved and most occur amongst diminishing stands of native grassland on farmland or along road and freehold creek frontages.

Bc 42^b: Fiery Jewel butterfly. A female was seen resting on a Golden Wattle in Yellow Gum–Red Box box–ironbark woodland (12.3) on 6 January 1993. A fresh male was seen hill-topping eucalypt saplings on a spur in the same locality on 16 December 1993. The butterfly larvae are attended by an ant (*Papyrius* sp. *nitidus* complex), a small brown ant with an orange head and a strong odour, referred to as the ‘coconut ant’. A large colony (over 50 nests and 0.1 ha), occurs where both observations of the butterfly were made. Nests are always located on well drained, sunny aspects. At Plenty–Janefield they occur beneath and on the lower part of shrubs, in dead wood near the base of Yellow Gums, under rocks and in the ground. Stumps, logs and old fence posts also contain ant nests and the bare ground and litter for some distance around the nests is honeycombed with entrances and sub-surface chambers and tunnels. Only one ant colony has been located to date in the Plenty Gorge, typifying its localised distribution and apparent rarity in NEM.

Byres of fine leaf and grass litter cover many nests, particularly on Golden Wattles (most likely larval food-plant). Byres are also located on Wedge-leaf Hop-bush, Woolly Wattle, Black Wattle and Lightwood, each being potential larval food-plants. The larvae feed at night in association with the ant. They skeletonise the leaves, leaving a characteristic ‘scorched’ pattern (Michael Braby pers. comm.). They are thought to develop slowly from hatching around late February until pupation around late November. Nocturnal searches for larvae are yet to be conducted at Plenty–Janefield.

Butterfly colonies in southern Victoria appear small and localised. Having an inland distribution, larval development near Melbourne is likely slowed by the cool, damp climate and the species was probably always restricted to relatively arid pockets such as Janefield (Fabian Douglas pers. comm.). Adults have a relatively brief flight season (mid-December to late January) and are well camouflaged whilst perched by the pattern of their hind-wings. Males hill-top amongst leaves in the canopy of shrubs and low trees rather than tree-tops like the Blue Jewel. Searches need to be centred on locating nocturnal activity centres of ants on potential larval food-plants.

The Fiery Jewel is listed as rare in Victoria (Douglas 1995). It has been recorded historically from about a dozen localities and over recent decades, appears to have been eliminated from a third of these (e.g. Montrose and Ocean Grove). The species is regionally endangered in GM, being recently recorded at only one other locality (near Hurstbridge). There are secure breeding populations in the Little Desert and southern Big Desert but populations elsewhere appear isolated and threatened.

Critical Assemblages or Populations

Cl 42^b: High diversity of reptiles; Janefield Mine to Dry Quarry reptile census, March 1992. Fourteen species of reptiles and eight species of frogs were recorded during a 3-hour census between Janefield Spur and Dry Quarry on 25 March 1992. The area from Janefield Spur to Dry Quarry, including the Plenty River and its eastern escarpment apparently contains all the species except the Marbled Gecko and Large Striped Skink, recorded in the herpetofauna study conducted on the west side of the river (see *Dd*). The Eastern Small-eyed Snake was recorded in cliffs on Janefield Spur on a prior visit.

An interesting feature is the occurrence of volcanic plains species (e.g. Cunningham’s Skink and Little Whip Snake) in the exfoliating shale slabs of Dry Quarry. The exposed spurs and escarpments above Dry Quarry under Yellow Gum–Red Box box–ironbark woodland (12.3) support the Tree Dragon and Bougainville’s Skink. The Common Long-necked Tortoise and Growling Grass Frog were recorded at Blue Lake.

Along the river, the Blotched Blue-tongued Lizard was recorded in Muttonwood riparian scrub (18.1), while the Southern Water Skink and Red-bellied Black Snake were recorded in Manna Gum (terrace) floodplain riparian woodland (16.5), south of Janefield Mine. The Common Blue-tongued Lizard, Tussock Skink, Eastern Three-lined Skink and Common Spadefoot Toad occupy the Kangaroo Grass–Common Tussock-grass (under grassy woodland; 16.2) Tertiary volcanic cappings south of the Blue Lake property.

The White’s Skink was located on Janefield Spur in the Tertiary river alluvium under Hill Manna Gum sand-plain woodland (15.1) and associated understorey of Black Wattle and Burgan (thickets) and Austral Bracken and Kangaroo Grass. The Bibron’s Toadlet was located amongst fallen timber in Mazus Gully (tributary of Satyrinid

Gully), under Swamp Gum gully woodland (10.3). The Lowland Copperhead was seen at a dam in the headwaters of Satyrinid Gully.

Db 42^b: High diversity of avifauna. The Plenty–Janefield and Yarrambat sites offer the highest topographic/habitat diversity in GM. Plenty–Janefield also has the highest geological/soil type diversity in GM. There are three ecological assemblages (biotas) at Plenty–Janefield. The biotas and their most important vegetation sub-communities include: (1) basalt plains–grassy woodland (14.1/14.2) and cliff/escarpment shrubland (Lightwood–Tree Violet; 20.5); (2) sedimentary foothill–gully woodland (10.1/10.3), box–ironbark woodland (Yellow Gum; 12.3), escarpment woodland (13.1/13.2/13.3), riparian scrub (18.1) and cliff/escarpment shrubland (20.2/20.4); (3) alluvial plain–grassy woodland (14.3), sand–plain woodland (15.1/15.2), plains riparian woodland (16.4/16.5) and seasonal wetland (25.4). The sand–plain woodland and seasonal wetland have a strong coastal influence.

Significant plains species include the Little Eagle, Little and Purple-crowned Lorikeets, Red-rumped Parrot, Western Gerygone, Brown Songlark, Brown Treecreeper and Spiny-cheeked Honeyeater. Significant foothills species include the Whistling Kite, Swift Parrot, Black-eared Cuckoo, Leaden Flycatcher, Red-capped Robin, Speckled Warbler and Black-chinned, Fuscous and Painted Honeyeaters. Significant alluvial plains/riparian species include the Nankeen Night Heron, Grey Goshawk, Collared Sparrowhawk, Rainbow Bee-eater, Australian Raven and White-eared and Crescent Honeyeaters. Some annotations of species not previously discussed including birdlists provided by the Council of Adult Education (per. Anthea Fleming) and Gary Backhouse include:

- Rainbow Bee-eater and Brown Treecreeper: colonies of 6–10 birds on Janefield south spur until 1988/89 (Yellow Box–Red Stringybark box stringybark woodland; 11.2)
- Collared Sparrowhawk: becoming more frequent along the river and gullies (10.1, 16.4, 18.1)
- Whistling Kite and Brown Falcon: becoming infrequent due to urban encroachment onto the plains west of the river (14.1)
- Pink Robin, Bassian Thrush and Olive Whistler: rare winter visitors to Burgan thickets on the sand–plain west of Satyrinid Gully (15.2) and the river terraces (16.5)
- Budgerigar: recorded by Gary Backhouse; unknown whether native or escapee
- Australian King–Parrot and Azure Kingfisher: winter visitors seen on one occasion along the river, former in 1986 and latter in 1990 (16.4)
- Brush Cuckoo and Cicadabird: rare spring migrants to the gullies (10.1); possibly in transitory stop-over before moving on to upland areas to breed
- Rose Robin: pair breeding in Satyrinid Gully in early October 1992 (10.1).

Dd 42^b: High diversity of herpetofauna. Twenty-seven reptile and frog species have been recorded at Plenty–Janefield. The diverse physical environment and array of habitat assemblages creates the second-most diverse herpetofauna assemblage in GM (see Yarrambat site). The fauna is ecotonal between the Quaternary basalt and Silurian sandstone faunas. It is probably the most extensive and intact overlap of these remaining in GM, given that most other areas (e.g. Yarra Bend and La Trobe University) are in the suburbs.

Volcanic plains species (e.g. Little Whip Snake and Large Striped Skink) occur locally in association with the stony plains west of the river escarpment. The Tree Dragon is common in the basalt cliffs, particularly amongst the loose basalt screes. The Eastern Small-eyed Snake also inhabits the basalt screes. This species, characteristic of the sandstone on the east side of the river, is uncommon on basalt in GM. The grasslands on the Tertiary river alluvium under Hill Manna Gum sand–plain woodland (15.1) are particularly important for herpetofauna. The Tussock Skink and Eastern Three-lined Skink are fairly common. This is a rare occurrence of the Tussock Skink off basalt in GM.

Janefield herpetofauna study, January 1986 to September 1988. Details of area searches compiled from over 10 visits were kindly provided by Grant Turner. An unpublished report on the study entitled ‘Herpetofauna of the Bundoora–Mill Park–Janefield Regions’ was also provided. The study area contained the Plenty River and its alluvial terraces and the western escarpment and hinterland grassy woodlands from the Maroondah pipeline at Janefield South to the transmission line at R&D.

A description of the study area from south to north is as follows. High level alluvium terraces and escarpments (Maroondah pipeline). Band of Tertiary river alluvium followed by a band of Tertiary volcanics/black uniform clays. Isolated outcrops of Quaternary basalt cliffs and boulder screes at the rim of the river escarpment (e.g. top of Janefield south spur near the World War I ruins). Band of sandstone at Janefield Gully followed by Tertiary river alluvium at Tanunda Wetlands. Extensive section of Quaternary basalt cliffs and hinterland stony plains at R&D backing high level alluvium terraces and escarpments near the river (Pilularia Swamp).

Seventeen reptile species and seven frog species were recorded in the study. The report concluded that the main threat presented to the herpetofauna is through clearing and grazing which creates barriers to dispersal routes, isolates breeding populations and exposes dispersing juveniles to predation. Janefield was found to contain a herpetofaunal transition from grassland to forest communities. Annotations on significant reptiles from the report include:

- Common Long-necked Tortoise: viable populations in the Plenty River
- Marbled Gecko: two animals located beneath a tree stump amongst River Red Gums (grassy woodland; 14.1) at the top of the escarpment near R&D pipe track on 7 June 1987
- Blotched Blue-tongued Lizard: seen only in the riparian scrub (18.1)
- Cunningham's Skink: 'frequently sighted amongst rocky (basalt) outcrops (cliff/escarpment shrubland; 20.5) where there is evidence that viable, breeding populations exist'
- White's Skink: observed in only one area; several individuals in a damp grassy flat on a river terrace under Manna Gum floodplain riparian woodland (16.5) and dense Burgan thickets near the Pilularia Swamp at R&D
- Bougainville's Skink: not encountered on the western side and apparently restricted to the eastern (sedimentary) escarpments of the river; 'being a fossorial (burrowing) skink it requires a loose substrate soil'
- Eastern Small-eyed Snake: a female located amongst an embedded basalt boulder outcrop at the top of the escarpment (Lightwood–Tree Violet cliff/escarpment shrubland; 20.5) at R&D; 'the single specimen subsequently produced 2 offspring' . . . its apparent scarcity may be due to the abundance of suitable cover rather than a paucity of specimens'
- Little Whip Snake: moderately common in the Kangaroo Grass areas under River Red Gum grassy woodland (14.1) on the stony plains of R&D; 'not among the timbered outcrops where the small-eyed snake occurs'
- Eastern Brown Snake: dry grassland areas; 'feeds mainly on birds and small rodents'
- Tiger Snake: seasonal wetlands on the river terrace; 'reduces interspecific competition (with the brown snake) by feeding mainly on frogs'
- Red-bellied black Snake: recorded above Fissidens Gully (south of pipe track) on R&D.

Df **42^b: High diversity of butterflies—Plenty–Janefield ERA, a Threatened Butterfly Community in Victoria.** Twelve standardised butterfly surveys were conducted in the proposed Ecological Reference Area (1' grid: 37° 40' x 145° 05') between January 1993 and March 1994. Nine surveys were conducted in 1993: 6 January, 13 February, 18 March, 16 April, 6 October, 9 November, 27 November, 7 December and 16 December. Three surveys were conducted in 1994: 13 January, 2 February and 14 March. Forty breeding (or presumed breeding) species were recorded. These included 15 lycaenids (blues and azures), 7 satyrinids (browns and xenicas) and 12 hesperids (skippers and darts). This is the highest butterfly diversity per unit area recorded in GM, and possibly Victoria.

In addition, five irruptive species of non-breeding migrants were recorded (vagrants entering southern Victoria largely due to drought in inland Australia). These include: the Wanderer (6 January), Lesser Wanderer (13 February), Small Grass Yellow (6 January), Chequered Swallowtail (7 December) and Caper White (7 December). A female Miskin's Blue was feeding at flowering Sweet Bursaria on 24 January. This is the only record in NEM of this inland species which is regarded as vagrant in GM. Ecological research on the box–ironbark woodland and sand–plain woodland butterfly assemblage and their food-plants and attendant ants should

be undertaken in the ERA. Collection, interference or disturbance to butterflies or ants in the ERA other than for bona fide research should not be permitted.

Habitats in the ERA important for butterflies include: Manna Gum/Swamp Gum gully woodlands (gullies; 10.1/10.3); Yellow Gum–Red Box box–ironbark woodland (sandstone spurs on the eastern side of the gorge; 12.3); Long-leaf Box–Manna Gum, Yellow Box and Red Box escarpment woodlands (river escarpments; 13.1/13.2/13.3); River Red Gum grassy woodland (volcanic plains to the west of river; 14.1); Hill Manna Gum/Burgan sand-plain woodland (Tertiary river alluvium sand-plain; 15.1/15.2); Manna Gum floodplain riparian woodland (riverbank and terraces of the Plenty River; 16.4/16.5); and cliff/escarpment shrubland (sandstone cliffs on the eastern side of the gorge; 20.2/20.4 and basalt cliffs on the west side; 20.5).

Box–ironbark woodland largely occurs in the northern Victorian Goldfields area and far-western Victoria. Sand-plain woodland occupies near-coastal sand tracts of southern Victoria. This community appears to be ecologically related to box–stringybark woodland of the alluvial plains and foothills of southern Victoria. Members of the box–ironbark woodland butterfly assemblage share a characteristic geographic range in Victoria (Dunn & Dunn 1991). The main distribution of the assemblage lies in the 400–700 mm annual rainfall belt of the lowland plains and foothills inland of the Great Dividing Range. There are small extensions into the plains and foothills of southern Victoria around the Grampians and north and west of Melbourne.

Occurrences of members of the butterfly assemblage correlate closely with the combined distributions of Yellow Box/Grey Box and Yellow Gum/Red Ironbark. The assemblage is richest where extensive overlaps occur (e.g. Little Desert, Stawell–Grampians, Bendigo–Castlemaine, Broadford–Tallarook, Brisbane–Lerderderg–Pyrete Ranges near Bacchus Marsh and Plenty Gorge). The box–ironbark woodlands of the latter two areas lie in a biogeographic corridor for inland fauna through the Kilmore Gap in the Great Dividing Range.

Rare or localised members of the butterfly assemblage recorded in the Plenty–Janefield surveys include: the Dark Purple Azure, Genoveva Azure, Fiery Jewel, Blue Jewel, Large Ant-blue, *Icilius* Blue, *Ictinus* Blue, Chequered Blue, Fringed Blue Miskin’s Blue and Rare White-spot Skipper. Common members include: the Olane Azure, Double-spotted Line Blue and Pea Blue.

In Greater Melbourne, sand-plain woodland, escarpment woodland, grassy woodland and box–ironbark woodland are largely restricted to the lowlands. These areas have been substantially settled and the communities are threatened from past and present land management practices. Within North East Melbourne, they are largely restricted to the Plenty Lowland Hills (now mostly fragmented bushblocks or advancing urban areas) and Yarra Lowland Alluvial Plains (now mostly suburbs). They also occurred at localised sandstone or granitic outcrops on the volcanic plains (now heavily cleared). Stands in the Plenty–Janefield ERA form the most extensive and intact remaining in NEM.

Significant box–ironbark woodland species: refer to *Ba*, *Bb* and *Bc* for accounts of the threatened species

Olane Azure. This species is widespread in the gorge and males were frequently recorded hill-topping around dead limbs in the canopy trees of spurs (12.3 and 13.2) above the escarpment of the gorge on all visits between 9 November and 2 February. Larvae feed locally on Drooping Mistletoe and Box Mistletoe. On 18 March, a larva and the small, shiny black attendant ant (*Crematogaster* species; the same attends the larvae of the Blue Jewel) were located under a strip of bark at the base of a Drooping Mistletoe on a Yellow Gum. Box Mistletoe also grows locally on Yellow Box and Red Box. Drooping Mistletoe grows locally on Yellow Box, Manna Gum, Swamp Gum, Yellow Gum, Red Stringybark, Long-leaf Box, and occasionally Blackwood.

Dark Purple Azure. The larvae feed on Creeping Mistletoe and associate with a small black ant (*Crematogaster* species). A pupa was located under bark on a Red Box to the east of the gorge on 9 November (12.3). Several Dark Purple Azure pupae had been previously located under bark near clumps of Creeping Mistletoe on River Red Gums and Long-leaf Box (14.1/14.2) on the volcanics to the west of the gorge at R&D on 13 February. The butterfly/ant and the mistletoe have been observed nearer Melbourne in the La Trobe University–Mont Park area. The mistletoe (like Drooping Mistletoe), also grows on well-established, introduced oaks and prunus in the suburbs. The ant and the azure do not normally persist in this situation.

Imperial White. This species is very common in the Plenty Gorge. Adults emerge from late August and fly until early December, with smaller numbers emerge for a second flight season from late January to March. Larvae have been recorded feeding locally on Drooping Mistletoe (12.3) and Creeping Mistletoe (14.1/14.2) and on one occasion, Grey Mistletoe (on a Silver Wattle growing above the riverbank near Blue Lake; 16.4). They do not require an ant association. The Imperial White occasionally associates with Drooping and Creeping Mistletoe on exotic trees in the suburbs.

Blue Jewel. On 6 January, adult females were seen flying amongst a stand of senescent Black Wattles on Janefield Spur (15.1). The wattles were riddled with longicorn beetle larvae holes. The butterfly larvae shelter in these or under bark during the day and associate with a small shiny black ant (*Crematogaster* species). Several males hill-topped a Yellow Gum (12.3) on a spur above the gorge in the late afternoon of all visits between 9 November 1993 and 13 January 1994. They competed (also with Large Ant-blues on 27 November) for territorial vantages on the upper canopy foliage.

Chequered Blue and Fringed Blue. Sightings of Chequered Blues were made on 6 January, 13 February and 7 December. A female was seen laying eggs amongst Saloop Saltbush (family Chenopodiaceae) on 13 February (12.3). Several other members of the plant family are present which are documented larval food-plants elsewhere. A female Fringed Blue was seen ovipositing on the stem near terminal buds of a Large-leaf Bush-pea (12.3) on 6 January. This regionally rare butterfly has been recently recorded from only two other sites in NEM (sites 77 and 104).

Significant gully/riparian species recorded during the butterfly surveys:

Two gullies with sheltered southern aspects that are important for butterflies occur in the southern (Janefield) section of the Ecological Reference Area. The relatively intact flora of both gullies is indicative of protection from extensive livestock grazing. The larger gully (Satyrinid Gully) supports a stand of Manna Gum gully woodland (10.1; containing species such as Tall Sedge which are characteristic of the upland hills in NEM). The gullies rise within or adjacent to the park.

Satyrinid Gully supports the most diverse assemblage (7 species) of Satyrinid butterflies (browns and xenicas) in the Plenty Lowland Hills. There are large populations of several of these species (particularly Shouldered Browns and Eastern Ringed Xenicas in late summer/early autumn). Some of the species are absent nearer Melbourne. Satyrinid Gully is broad and grassy with sunny openings. A smaller gully to the east is narrower and more shaded and contains a smaller catchment. Large stands of Thatch Saw-sedge occupy its sandy, sheltered slopes. These gullies and the adjacent section of the Plenty River, support the most diverse assemblage (12 species) of Hesperid butterflies (skippers and darts) in the lowland hills.

Spotted Brown, Bank's Brown and Cyril's Brown. The Spotted Brown was seen on 13 February (10.3), the Bank's Brown (10.1) on 16 April and the Cyril's Brown (hill-topping 13.2), on 6 October. In recent years in the Plenty Gorge, each species has only been recorded in Satyrinid Gully. Their preferred breeding habitat in the lowlands is largely contained in gullies. Grey Tussock-grass and Weeping Grass (each in Satyrinid Gully) are known larval food-plants of each in the uplands of NEM. Common Tussock-grass (sheltered escarpments of the Plenty River and Satyrinid Gully) has also been recorded for the former two butterfly species, while the larvae of the Cyril's Brown are also known to feed on Slender Tussock-grass (shaded gullies and banks of the Plenty River).

Each butterfly is now threatened in the lowland hills. Their breeding habitat in the Plenty Gorge is threatened by the invasion of Blackberry and Three-cornered Garlic. The latter is one of the most serious environmental weeds along streams in the lowlands of NEM. The maintenance of populations will require weed control.

Donnysa Skipper and Spotted Skipper. These are characteristic of the upland hills of NEM. Breeding populations (larvae/pupae in shelters) of both were located on 6 October amongst Thatch Saw-sedge (13.2). Adults of both were subsequently observed taking nectar from flowers in a nearby stand of Burgan on 7 December.

The two skippers and the three previous Satyrinids were formerly widespread in the lowland hills. Land clearing for farming and housing and grazing of gullies has caused their main distributions to contract to the upland hills and ranges. Only small and isolated populations remain in the inner lowland hills. The gullies of

the southern section of the ERA form the only area in the Plenty Lowland Hills (and nearest remaining occurrence to Melbourne) for the five species. An objective of the ERA should be to design specific revegetation programs to enable population recoveries of each. Maintenance of populations in the Janefield gullies will require management such as weed control and protection from human interference (including collection) and degradation (particularly pedestrian and horse trampling).

Doubleday's Skipper. This skipper inhabits damp coastal forests in eastern Victoria and has a predominantly sub-tropical range extending to southern Queensland. Melbourne represents the south-western limit. It was locally common in the southern section of the ERA on all visits from 9 November to 16 December (10.1, 13.2, 15.2). In central Victoria, the larvae feed primarily on Weeping Grass in lowland areas and Forest Wire-grass (present in sheltered gullies of the gorge escarpment) in higher rainfall upland areas. A range expansion has occurred into the Nillumbik and Plenty Lowland Hills from a previously small area of occurrence in the Yarra Lowland Hills near Warrandyte (and south in wetter areas between Ringwood and the Dandenongs). This appears to have been in response to the succession of favourable cool and wet spring/summers in 1992 and 1993, and associated flush of food-plants.

Dingy Dart. Melbourne also represents the south-western limit of the Australian range of the Dingy Dart. A fresh adult was observed on a river terrace south of Janefield Mine on 27 November (16.5). The larval food-plant (Blady Grass) was located nearby. This plant also grows on the basalt cliffs upstream at R&D. The butterfly is known in NEM from few localities (e.g. Plenty River at Lower Plenty, Yarra River at Eltham South). The Dingy Dart is a sub-tropical species extending into temperate coastal areas of Victoria.

Fb **42^b: High population density of Swift Parrots—Goldsworthy Lane Yellow Gum nectarfauna census.** The Yellow Gum–Red Box box–ironbark woodland (12.3) between Janefield and River Avenue is the most important feeding area for Swift Parrots and lorikeets in NEM. The occurrence of Yellow Gum box–ironbark woodland in NEM is disjunct and restricted to Plenty, Research and Yarra Bend. It occurs elsewhere in GM at the foot of the You Yangs, in the Brisbane and Lerderberg Ranges, at Long Forest, Toolern Vale and Sunbury. Long-term ecological studies were conducted to determine the relationship between Swift Parrot and lorikeet visitations and Yellow Gum nectar flows. In heavy flowering years the Yellow Gums produce nectar uniformly through the day from mid-winter to early spring and sustain a large population of Swift Parrots over the period. Nesting surveys in Tasmania indicate that the Swift Parrot population has declined from 1320 pairs in 1989 to 940 pairs in 1995.

Swift Parrot counts. The number of feeding birds were recorded between 1977 and 1992 in an annual (July) 2 hour/4 km circuit of Yellow Gum–Red Box box–ironbark woodland from Memorial Drive spur, Goldsworthy Lane, Oatland Road to Janefield Spur. Counts from 1977 to 1982 ranged from 0 to 30. These increased after the 1982 drought. The count in July 1990 was 90 birds. A single flock of 400 to 500 birds (up to 20% of the total population) was seen passing through in a south-easterly direction in the late afternoon of 28 April 1990. These were possibly most of the birds in GM at the time. On the next evening the flock was intercepted flying over Yandell Reserve at Greenhills (site 44), still heading south-east. On the evening of 30 April, 100 birds were located roosting along the Diamond Creek downstream of Eltham from Wingrove Park to the confluence with the Yarra River and upstream along the Yarra to Griffith Park (site 35). The population of Swift Parrots seen on 28 April 1990 was the largest aggregation of the species recorded in GM.

Over the 16 years some important feeding grounds have been fragmented or cleared elsewhere in GM. Much of the Yellow Gum, Yellow Box, Grey Box and River Red Gum where large flocks of Swifts Parrots have been sighted is on private land and subject to increased development and associated clearing/fragmentation. The consolidation under conservation management of the entire stand of the Yellow Gum–Red Box box–ironbark woodland in the Plenty–Janefield site must become a nature conservation priority.

Goldsworthy Lane nectarfauna census. The 2 ha census plot occurs in a stand of Yellow Gum–Red Box box–ironbark woodland along Goldsworthy Lane (see Regional Habitat Link Strategy). Full daylight counts and nectar secretion rates were recorded at 30 minute intervals in the Yellow Gums on 8 July 1977. Annual 20 minute counts of birds and measurements of nectar secretion were conducted between 1000 and 1020 hours during a sunny and calm period in the second week of July from 1977 to 1992. Avifauna summaries for the three peak flowering years are provided (8 July 1977, 13 July 1983 and 8 July 1990).

Tree clearing and fragmentation due to house building and increased levels of cattle and horse grazing in perimeter stands along Oatland Road has occurred. Only the section on Janefield Spur and Memorial Drive spur has essentially remained intact over the 1977-92 census period. The rates of nectar and blossom production and flowering trees peak in about 6-7 year cycles (1977, 1983 and 1990). The peaks and troughs in production over successive cycles have remained constant. This is interesting to compare with those of the Red Ironbarks at Yarrambat (and elsewhere) which have declined.

Plenty Yellow Gums: Results

1977 bird summary: 9 species and 140 individuals including the White-plumed Honeyeater (20), Red Wattlebird (25), Spiny-cheeked Honeyeater (1), Regent Honeyeater (1), Noisy Miner (2), Musk Lorikeet (50), Little Lorikeet (4), Purple-crowned Lorikeet (35) and Swift Parrot (2).

1983 bird summary: 9 species and 119 individuals including the White-plumed Honeyeater (20), Red Wattlebird (35), Little Wattlebird (2), Spiny-cheeked Honeyeater (1), Noisy Miner (8), Musk Lorikeet (28), Little Lorikeet (4), Purple-crowned Lorikeet (16) and Swift Parrot (5).

1990 bird summary: 10 species and 119 individuals including the White-plumed Honeyeater (30), Red Wattlebird (40), Little Wattlebird (2), Spiny-cheeked Honeyeater (2), Noisy Miner (10), Rainbow Lorikeet (2), Musk Lorikeet (16), Little Lorikeet (2), Purple-crowned Lorikeet (5) and Swift Parrot (10).

Plenty Yellow Gums: Discussion. The Yellow Gum census plot contains 90 Yellow Gums with DBH exceeding 30 cm and is situated in the largest stand of Yellow Gum box-ironbark woodland (about 100 ha) in NEM. Most of the stand is now incorporated into Plenty Gorge Park. The plot remained uncleared during the 1977-92 census period but over the last five years of the census was grazed heavily by livestock and the eucalyptus saplings and shrubs were eaten back. A section adjoining the plot was cleared to make way for a house in the early 1980s.

The plot abuts cleared land to the west and south. This fragmentation has favoured edge-inhabiting species such as the Noisy Miner and species which successfully cohabit with settlement (e.g. Rainbow Lorikeet and Red and Little Wattlebirds). The overall counts declined only slightly over the 3 peak flowering years from 140 in 1977, to 113 in 1983 to 119 in 1990. Of these, the lorikeets declined from 89 in 1977, to 45 in 1983 to 25 in 1990. This decline in lorikeets was balanced by an increase in fragmentation species (Noisy Miner and Red Wattlebird) from 27 in 1977, to 43 in 1983 to 50 in 1990.

The Yellow Gum had a constant rate of nectar production through the day and the nectarfauna visitation rate was also even throughout the day. As an open woodland (about 45 mature trees/ha), it attracts differing guilds, predominantly Swift Parrots, Noisy Miners and lorikeets, to those occurring in the more closed Red Ironbark-Yellow Gum box-ironbark woodland at Yarrambat (site 40).

Significant changing trends in the avifauna associated with the increasing rate of fragmentation around the edge of the Yellow Gum woodland area were observed. The first was the increased dominance of several species (particularly the Noisy Miner, Red Wattlebird, Spotted Turtle-Dove and Common Myna). Further housing development and stand fragmentation would favour these edge-inhabiting species which successfully cohabit with settlement. The second trend was the noticeable decline in the visitation rate of the Purple-crowned Lorikeet. This is linked with the preceding trend and the encroachment of residential development into the woodlands of the district (see below). The third trend was the increase in visitation rate of the Swift Parrot (see above).

Nectarfauna summary:

White-plumed Honeyeater and Red Wattlebird. These were resident in the Yellow Gum census plot. They occurred at about equal densities and were the most common nectivores except in peak nectar/flowering years when Musk Lorikeets were present.

Little Wattlebird. They first appeared after the 1982 drought. At Plenty they have increased with residential encroachment due to their aggressive nature, tolerance of human disturbance and ability to utilise non-indigenous native gardens. This, and the creation of edges and fragments of forest by clearing has provided an advantage for them over smaller, forest honeyeaters such as the White-naped and Brown-headed Honeyeater which do not inhabit close settlement. They are expanding into bushland in the Plenty Gorge with the creation of forest edges and fragments due to clearing.

Regent Honeyeater. One bird was present on the census plot on 8 July 1977. The Regent Honeyeater is a pugnacious species but being heavily outnumbered by the wattlebirds and miners, was subsequently chased away. The species has not been observed in the site since but is likely to occasionally visit in heavy flowering years and during local movements between Yarrambat and the Yarra River. Regeneration of the understorey and decreasing the degree of fragmentation of the stand would assist the honeyeater but its overall population is now so low that a numerical return to the site is unlikely. A bird was seen in 1966 in the gully on McLaughlans Lane east of Happy Hollow Drive (Reg Johnson pers. comm.). The area has been grazed for many years and has become degraded by Blackberries and other weeds. A Bell Miner colony has been present in recent years and the Swamp Gums show severe dieback.

Spiny-cheeked Honeyeater. A single bird was recorded in each peak flowering year on the census plot. They are autumn-winter visitors probably from the coast to the Yellow Gum escarpments along the Plenty River. They have been observed taking the fruit of African Box-thorn, Tree Violet and Box Mistletoe when ripening during autumn. Nectar is taken from Yellow Gums and Grey and Creeping Mistletoes in winter. Insects are gleaned from foliage or probed from under bark or branch crevices and occasionally hawked from sallies. In the census plot they were constantly involved in territorial squabbles with wattlebirds, particularly the Little Wattlebird.

Noisy Miner. A colony was resident at the census plot throughout the 16-year study. In the late 1970s colonies were patchy in the 100 ha woodland stand. They now more or less totally occupy it. Colonies occupy 4-5 ha and contain highly territorial groups, each of 6-20 birds occupying 1-2 ha. The ratio of males to females in a colony can be as high as 5 to 1. At Plenty they glean foliage and bark invertebrates, particularly the lerp covering of psyllids from Yellow Box and Yellow Gum leaves, often leaving the insect unharmed beneath. In this sense, they farm psyllid insects and promote tree defoliation and dieback. They take blossom nectar from the mid-level of woodland trees and spend about equal amounts of time on the ground foraging for invertebrates. Soft fruit (e.g. wild prunus and African Box-thorn) and manna exudates from eucalypts and wattles are also taken. The Noisy Miner overlaps with the Bell Miner near the river at Janefield (open woodland and denser riparian and escarpment woodland habitats respectively) and together cause significant defoliation and dieback of Swamp Gums, Red Stringybark and Yellow Box.

Rainbow Lorikeet. They first appeared on the census plot in 1985 and have been recorded in most years since. A population increase and range expansion of Rainbow Lorikeets from urban Eltham and Greensborough is occurring, where they nest in Manna Gums along streams. Rainbow Lorikeets are likely to increase in numbers and firmly establish, particularly as residential encroachment occurs. Before settlement, they were probably autumn-winter visitors from the coast to Tree Banksia (on sedimentary escarpments of the Plenty River) and Yellow Gum during their flowering seasons, but were probably neither resident nor common.

Musk Lorikeet. They were the most common nectivore in the census plot during peak nectar/blossom years but seldom more than a pair were seen in other years. They are locally nomadic and large influxes occur into the flowering Yellow Gums during the winter of peak flowering years (e.g. winter 1977). They are involved in constant territorial interactions with Noisy Miners. They predominantly take nectar but have also been observed taking eucalyptus buds and seeds and the sugary lerp covering of leaf psyllid insects.

Purple-crowned Lorikeet. Large influxes into the Yellow Gums occurred in 1977 and 1983 during which they were nearly as abundant as the Musk Lorikeet in the census plot. At these times seasonal camps were established along the Plenty River. They are not resident in the Yellow Gums and appear in a winter influx on about 6-7 cycles during prolific flowering. These influxes may be from the Plenty/Merri Volcanic Plains or from dry country west of Melbourne or inland Victoria. They also visit plantation eucalypts, particularly Sugar Gum when it flowers in late summer.

Purple-crowned Lorikeets are present throughout the year and breed during the spring in River Red Gum grassy woodland (14.1) on the Plenty/Merri Volcanic Plains. They are nomadic and irregular visitors elsewhere in NEM. In addition to Yellow Gum nectar, lerps and pollen were taken in the census plot. It has been reported that they extract pollen from young flowers and nectar from older flowers (Blakers *et al.* 1984). Their staple food in the River Red Gums on the volcanic plains is the secreted, sugary lerp covering of leaf psyllid insects. This is supplemented by eucalyptus buds and seeds and nectar when available. Unlike the Musk Lorikeet, this species

seldom enters urban bushland in NEM. Visiting populations of Purple-crowned Lorikeets declined during after the late 1980s.

Little Lorikeet. A small number appear to be resident in the 100 ha stand of Yellow Gum box–ironbark woodland at Plenty and a pair was recorded on the census plot in most years. Similar to the Purple-crowned Lorikeet, they mainly occur in woodlands of gum-barked eucalypts. They are the most sedentary of the smaller lorikeets and do not form large groups, simply an aggregation of a few pair. They feed on Yellow Gum nectar and lerp in the census plot. They are resident throughout the River Red Gum woodlands and Manna Gum riparian forests in the Plenty and Yarra Valleys. At intervals of 5-10 years (e.g. 1981/82 and 1991/92), summer influxes enter flowering River Red Gums and Manna Gums in the Plenty and Yarra Valleys. These may come from as far afield as the north-eastern coast of New South Wales.

Feeding behaviour and diet of the Little Lorikeet is similar to the Musk Lorikeet. Psyllid lerp and blossom of River Red Gums, Manna Gums, Swamp Gums and Yellow Box are particularly important. The River Red Gum belt on the north-eastern outskirts of Melbourne is a stronghold for the species in southern Victoria. Mature River Red Gums suitable for tree-hollow nesting species such as the Little Lorikeet should be retained wherever possible in developing areas (e.g. Blossom Park). The Little Lorikeet occurs in highest numbers in dense and extensive woodland stands (e.g. at La Trobe University and near Yan Yean). The thinning and decline of River Red Gums on farmland near Melbourne has depleted and fragmented their range. These woodlands lack adequate replacements and as trees die, future hollow shortages could eliminate this lorikeet.

Swift Parrot. The census plot is situated in their most important feeding area in NEM. Swift Parrots increased in numbers on the census plot during the 1980s. They were present only during prolific flowering years from 1977-83 but were recorded annually from 1986 to 1990. They have not been recorded since 1990.

Other Significant Fauna

Birds

Eb **42^b: Western Gerygone.** One of the rarest birds in NEM with only two sightings in the last 10 years. One of these was on 21 December 1990, of a breeding pair with young on a nest in Yellow Gum–Red Box box–ironbark woodland (12.3) along Memorial Drive spur, north of Dry Quarry. Small numbers enter GM (mainly between Bacchus Marsh and Sunbury) each year as spring-summer migrants from inland eastern Australia (e.g. the Mulga scrubs of central Queensland) arriving mid to late October. The pendant nest near Dry Quarry resembled that built by the White-throated Gerygone, but was placed much lower to the ground (about 1.5 m, hidden amongst entwined Coarse Dodder Laurel and Burgan foliage). The young were well advanced and the adults spent most of their time foraging for insects amongst the Burgan.

Ec **42^b: Black-eared Cuckoo and Red-capped Robin.** A pair of Speckled Warblers and family of Buff-rumped Thornbills, busily attended a well advanced Black-eared Cuckoo fledgling at Memorial Drive spur on 21 December 1990 (Yellow Gum–Red Box box–ironbark woodland; 12.3). Red-capped Robins with two fledged young were observed nearby.

42^b: The waterbirds of Blue Lake. The lake does not support resident waterbirds due to the deep water, rocky substrate and paucity of aquatic vegetation and vegetable and invertebrate food supplies. Lake birdlife would benefit from the placement of more rocks along the shoreline and the introduction of submerged and emergent aquatic vegetation (e.g. milfoils, pondweeds and River Club-sedge and Tall and Common Spike-sedge). Disturbance from high levels of human activity (e.g. swimmers in summer) deter waterbirds from the lake.

Around 25 species of waterbirds have been recorded at the lake. Occasional Hoary-headed and Australasian Grebe visit in winter. Australian Wood Ducks shelter on the shores of the lake in the evenings. Australian Coot, Little Pied Cormorants and smaller numbers of Little Black Cormorants visit Blue Lake (probably from Tanunda Wetlands). The cormorants roost between feeding during the day on several large rocks at the waters edge in the south-east corner. These and occasional Australian Pelicans feed on the Redfin and Rainbow Trout which have been released into the lake. Both fish species should be replaced by native species such as the Freshwater Blackfish and Southern Pigmy Perch. The Nankeen Night Herons which camp nearby along the river visit to

feed at night. A Darter and a Great Cormorant were seen flying along the Plenty River between the two lakes on 23 June 1992.

Mammals

42^b: Bat roosts in the quarryface at Dry Quarry. The slabbing quarryfaces, particularly of Dry Quarry, support numerous small caves and crevices. The Lesser Long-eared Bat and Chocolate Wattled Bat were located behind crevices in the slabbing shale face. There is a possibility that the Large-footed Myotis is also present. Fairy Martins also nest in the caves.

42^b: Janefield block—important for arboreal and ground mammals. Only incidental mammal trapping has been conducted. Spotlighting revealed that the river section contained a high population of Sugar Gliders and other arboreal mammals (particularly the Janefield south spur area). The gliders are important prey of Barking Owls, which nested near Janefield Mine, about 500 m upstream in October 1992. A Brush-tailed Phascogale was recorded in this section in the mid-1980s. The Feathertail Glider probably also occurs along the river.

The Long-nosed Bandicoot was recorded in 1987 (John Orr pers. comm.). This is probably locally extinct. Trapping should be conducted in the gullies for small ground fauna species such as the Bush Rat and Brown Antechinus which may persist. Predation from cats and dogs and disturbance and habitat degradation by humans, arising from residential development will impact heavily on these species. This formed the closest occurrence of the bandicoot to the Melbourne CBD during the survey period.

Unless extensive bushland areas and a predator fence separate housing development from the river section, the chance of long-term survival of the bandicoot (if they still survive) would be low. The extent of the ground mammal populations along both sides of the river should be established before any meaningful lines on maps regarding the adequacy of buffering habitat could be drawn. Development upstream at Blossom Park which lies close to the western escarpment has bottlenecked the movement of the small ground fauna and some of the larger species such as the Black Wallaby and Common Wombat. Residential development at north Watsonia, to the south of the Janefield block, is limiting the population viability of these species.

42^b: Platypus. One was seen in a waterhole in the Plenty River beside Blue Lake on 17 January 1989. Another sighting was made in the same pool in early 1992 (Ian Chapman pers. comm.). The species would likely breed in the area. This constitutes their most downstream breeding locality in the Plenty River system.

Freshwater fish

Ec **42^b: Flat-headed Gudgeon.** Five were electrofished on 15 December 1988 from the R&D/Maroondah pipetrack rapids, upstream of Dry Quarry. Despite good substrate and riparian conditions the water quality appears poor for native fish, but conducive to alien species. Over 500 Roach and one Weather Loach were taken. The Short-finned Eel and introduced Redfin and Rainbow Trout occur in Blue Lake.

42^b: Electrofishing Survey: Plenty River–Plenty Gorge at R&D/Maroondah pipetrack rapids

Map reference. 7922 315294. **Altitude.** 80 m. **Survey date.** 15 December 1988

Vegetation. Instream: emergent herbfield. Bank: Manna Gum (riverbank) floodplain riparian woodland (16.4; fair condition); Muttonwood riparian scrub (18.1; fair condition but advancing alien shrubs and herbs, particularly Cocksfoot, Blue Periwinkle and Three-cornered Garlic). Frontage: Long-leaf Box escarpment woodland (13.1; east side upstream; fair condition); Manna Gum (terrace) floodplain riparian woodland (16.5; poor condition); Golden Wattle cliff/escarpment shrubland (east side downstream cliffs; fair condition)

Physical Features:

Pools

Substrate. Silt and logs on sheet sandstone

Maximum size (mid-summer). 9 m wide by 2 m deep by 200 m long

Riffles

Substrate. Sandstone and basalt cobbles and pebbles, gravel and silt on sheet sandstone

Flow (mid-summer normal): **Size.** 3.0 m wide by 10 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 28.6 ML/day

Water quality

Summer: Temperature. 25°C. **Conductivity.** 650 ms. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Flat-headed Gudgeon (5); likely breeding resident

Alien species numbers/status. Roach (500); likely breeding resident. Weather Loach (1); likely breeding resident. Mosquito Fish (2); likely breeding resident

Other comments. The flow rate increased noticeably between Kurrak Road and this site without any major surface input. This section of the gorge is where the river has cut deepest through the bedrock, possibly intercepting groundwater from aquifers. The recharge of these aquifers may be from the low-lying swamps at Yan Yean or runoff from Quarry Hill or possibly further distant from the extensive artesian basins under the volcanic plains and the ranges. A Platypus was present in the large waterhole downstream. Land tenure: Plenty Gorge Park.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Intact habitat links upstream to the Kurrak Road and Yarrambat sites. Fragmented links downstream through the urban Yallambie to Greensborough site and to the east to the Plenty site. The Plenty–Janefield site contains the most downstream occurrences of several threatened and significant habitats along the Plenty River. It is the nearest remaining approach of extensive and highly significant bushland to Melbourne</p>	
<p>Land clearing/loss of habitat links through residential encroachment. Land clearing, habitat degradation and residential encroachment have reduced the long-term survival value of many of the threatened, rare or restricted species</p> <p>Avifauna changes due to land clearing and housing in the Yellow Gum area. Bird populations have altered and visiting rates of nectar-feeders such as the Musk and Purple-crowned Lorikeet declined over the 16-year census study at Goldsworthy Lane. Open space and edge species such as the Noisy Miner, Common Starling and Little Raven have increased dramatically. The reasons for this are largely due to surrounding land clearing resulting from farmlet subdivision and housing. Several Yellow Gum blocks adjoining Oatland Road have been thinned or cleared since the late 1970s.</p>	<p>Strengthen habitat links. Conservation of the Plenty–Janefield site is a key recommendation of the Regional Habitat Link Strategy. The stand encompassing the Goldsworthy Lane Yellow Gum census plot has been acquired into the Plenty Gorge Park. Management needs to promote shrubland and Yellow Gum regeneration. Blocks within the link which are cleared need to be replanted to close-out the present fragmentation .</p> <p>Conservation of the Yellow Gum area. Yellow Gum box–ironbark woodland stands in Plenty Gorge Park require active protection and conservation management. This habitat in association with other habitats including Swamp Gum gully woodland, Manna Gum floodplain riparian woodland and River Red Gum grassy woodland contained in the Plenty–Janefield ERA provide several of the preferred feeding habitats of the Swift Parrot in Victoria. The site is one of few areas where extensive stands of these habitats co-occur in Victoria. This is the key to its importance for Swift Parrots. The Yellow Gum area should be excluded from intensive recreational activities and promoted for scientific research.</p>

Melbourne Parks and Waterways Master Plan—trail network and visitor nodes. The trail network and visitor nodes proposed for east of the Plenty River will be highly detrimental to biological values. The most critical recommendations arising from this study are the Ecological Reference Areas. They are essentially non-public access areas. A major node planned for the River Avenue area and the trail impacts on the Plenty–Janefield ERA. The ERA concept is to protect from human impact and disturbance, areas containing the most significant occurrences of important, rare and sensitive species (e.g. butterflies, orchids, etc.), habitats and landforms within the biological reserve system. The ultimate provision of areas such as ERAs was a primary reason why the park was established. The compromise of increasing levels of human disturbance in ERAs will lead to the disruption of integral ecological processes and restrict their function as biological reserves and ‘control’ areas for scientific research (both primary purposes of ERAs).

Impact of the Blossom Park development (see margin notes)

Implementation of the Conservation 1 Zone. Freehold areas adjoining the river in the Shire of Nillumbik containing bushland (including sections of the Yellow Gum woodland area) and strategic fire breaks have been rezoned Conservation 1. This area lies to the east of the Plenty Gorge Park and PPOS. The zone has strong environmental purposes and controls.

Regional Hydrological Strategy

Platypus decline. The long-term viability of populations of Platypus in the river opposite Blossom Park is poor, given the declining condition of the stream and advancing development. The entire Plenty Gorge population is at the cross-roads as streamway links upstream and downstream are becoming severed.

Electrofishing site—Blossom Park rapids. The water, while clear, is odorous and probably at least mildly polluted and Roach are dominant. Weeds and vermin are advancing on the western escarpment adjacent the residential areas downstream.

Melbourne Parks & Waterways management (see Appendix 4.3)

Controls on housing estate waste water and runoff. These should be designed to minimise the release of nutrients, litter and waste water and hard surface runoff into the river or its tributary gullies. The declining water quality of the river is a major concern. Further deleterious outflow from development will likely eliminate the Platypus and place additional stress on the instream ecosystem. Effort must be made to improve the water quality of the river as it is already well below acceptable public health standards.

Monitoring and adherence to water quality controls in the Plenty River.

Threatening Processes—Other Issues

High fire hazard. The north-south orientation of the gorge as it enters the site will act as a funnel for fires starting further upstream. The prevailing winds in the gorge sweep fires from north-west to south-east. The change to an east-west orientation in the centre of the site makes residential areas in the Corowa Crescent section of Greensborough particularly vulnerable. Grazing of the open country on the south side of the river reduced this fire risk. As regenerating bushland, much of the regrowth is likely to be Burgan. While this species is important for wildlife it is also highly flammable. This will expose nearby residential areas to a high fire risk, unless a fire buffer of at least 100 m width is present.

Horse riding and illegal livestock grazing. Horse riders and trail bike riders, presumably visitors to Blue Lake and locals from the Memorial Drive, Oatland Road and Happy Hollow Drive area or closer to Greensborough at Apollo Parkways, continue to enter the park. Much damage to gullies and fragile escarpments is being incurred. Fences are frequently cut. For several years, Brahmin cattle from one of the properties on Goldsworthy Lane have been allowed to enter the Janefield bushland during winter. Despite closed gates and the owner being asked not to allow this to happen, the cattle enter the bushland. In wet years such as 1996, severe damage is done to the highly significant gullies and seepage areas. Disregard for conservation by many of the locals is possibly one of the most daunting tasks facing the park.

 Other Conservation Measures

Companion animals recommendation. That the City of Whittlesea and Shire of Nillumbik develop a companion animals strategy for residential areas abutting the Plenty Gorge. This should involve confining cats and dogs to owner properties. **This strategy should be uniformly applied throughout NEM for all residential (and proposed residential) areas in NEM adjoining sites of state or higher faunal significance.** The impact on the fauna of the gorge due to the loss of habitat and increased levels of disturbance arising from development has been severe. Wandering and dumped companion animals are placing further pressure on the wildlife. There is strong justification for cat controls given the faunal significance of the Plenty Gorge. Extinction of species in the gorge will be inevitable if the City of Whittlesea and Shire of Nillumbik do not fully address this issue.

42^b: Nomination of the Box–Ironbark Woodland and Sand-plain Woodland at Plenty–Janefield as a threatened butterfly community. The proposed Ecological Reference Area (ERA) supports the most extensive and intact stands of Yellow Gum–Red Box box–ironbark woodland and Hill Manna Gum sand-plain woodland in NEM. Substantial stands of both elsewhere in GM occur only in the Brisbane Ranges. The site contains the largest stand of Yellow Gum remaining near Melbourne. It also contains the most downstream occurrences of several threatened and significant habitats along the Plenty River. The ERA forms the nearest remaining approach of extensive and intact nationally significant bushland to Melbourne. This is best illustrated by its populations and diversity of significant species, particularly plants and butterflies.

The proposed ERA contains 40 breeding or presumed breeding species of butterflies. A further five non-breeding vagrants have been recorded. This is the highest known butterfly (and threatened butterfly) species diversity in GM. It includes the endangered Icilius Blue, vulnerable Ictinus Blue, Large Ant-blue and Genoveva Azure, rare Fiery Jewel and insufficiently known Rare White-spot Skipper. The box–ironbark and sand-plain woodlands area should be nominated as a threatened butterfly community under Schedule 2 of the Flora and Fauna Guarantee Act 1988.

Research on the Large Ant-blue and Fiery Jewel. Studies to locate and monitor the juvenile stages of the butterflies need to be undertaken at the attendant ant colony. The juvenile stages of the Large Ant-blue have never been located in Victoria, those of the Fiery Jewel are currently known in Victoria only from the north-western deserts. An ant-blue trap was specifically designed and laid amongst the colony. This consisted of a wooden strainer post sawn longitudinally, routed in the centre and clamped together with an apiary ‘m-lock’. A post laid in late December 1993 by a Golden Wattle that supported a Coconut Ant nest, was colonised by ants in February 1994. This is periodically inspected for juvenile stages of the butterflies, without undue disturbance to the ants. The area was being subjected to intensive grazing pressure from rabbits and hares. A small area has been fenced and understorey regeneration is occurring. A larger section is planned to be fenced.

Research proposal—establishment of a colony of the Eltham Copper in the Ecological Reference Area. The discovery or establishment of a colony of the endangered Eltham Copper butterfly in a large and secure biological reserve within the known range/habitat of the butterfly now appears a necessity if the species is to be assured of long-term survival near Melbourne. Likely areas of occurrence in Plenty Gorge Park have been searched without success. The spur where the Large Ant-blue and Fiery Jewel butterflies have been located is similar in habitat (Yellow Gum–Red Box box–ironbark woodland; 12.3) and all other respects (elevation, rainfall, topography/aspect) to the nearest known colony of the Eltham Copper at Yandell Reserve near Greensborough (site 44).

The butterfly may have been eliminated by logging, grazing or bushfires. The native understorey (particularly the food-plant of the butterfly larvae, Sweet Bursaria) has been depleted by grazing from hares and rabbits. There is a strong chance that the attendant ant (*Notoncus capitatus*; see site 49) of the butterfly larvae is present. Searches and pitfall trapping need to be undertaken. If it is present, a long-term program toward the re-introduction of the Eltham Copper should be undertaken.

First, the construction of an extensive rabbit proof fence is necessary (planned to be undertaken by Melbourne Parks & Waterways for protection of the Coconut Ant/Fiery Jewel butterfly colony). Seedlings of Sweet Bursaria (preferably of seed from Yandell Reserve) should be grown for planting on the spur. Translocation of butterfly larvae could then be undertaken (approval would need to be obtained from NRE). If the ant is not present, research would be required on whether it could be successfully translocated.

Research on the Plenty River ecosystem. The river sections are in need of scientific research, particularly on instream ecology. The fishway constructed at Dights Falls may realise the return to the Plenty River of threatened species such as the Australian Grayling and Spotted Galaxias and larger populations of the regionally rare Common Galaxias. A follow-up electrofishing/netting study to the survey conducted in 1988 (McKenzie & O'Connor 1989) is recommended. However, the weir at the Maroondah pipeline crossing at Janefield south would obstruct the passage of these migratory fish. This needs urgent removal. Comparison of both sets of data may provide information on the success of the Dights Falls fishway.

Conservation plan for new housing developments. Any new development must provide a far more generous buffer strip than has been provided in sections of Blossom Park Estate. Houses should face the gorge, fronting onto a boulevard. The boulevard and remaining buffer strip separating the gorge should provide a fire buffer and open space for passive recreation and a linear trail system. The road should divert garden and driveway runoff into effective retarding basins before entering gullies of the Plenty River.

Use and promotion of indigenous plants on private land. Councils should adopt total use of indigenous species in streetscape and parkland plantings. Residents need to be encouraged to use indigenous trees and shrubs in house gardens. Plants propagated from local stock should be made available through an indigenous plant nursery. Planting guidelines for prospective home owners should be a condition of new subdivision permits. The buffer strip between housing and the river escarpment should contain some cover of trees, low indigenous shrubs and unmown grassland. Basalt outcrops which are important for herpetofauna and grassland flora should be protected.

Implementation of Native Vegetation Clearance Controls on private land.

Avifauna Changes

Recent aerial photos show that the Yellow Gum stand has become internally fragmented and the change is noticeable on comparison with aerial photos taken in the 1960s. In 1977 the dominant understorey vegetation was Yellow Gum saplings, Black and Golden Wattles, smaller native shrubs and native grasses. Many blocks were ungrazed or only intermittently grazed by livestock. Over the following years, larger blocks were subdivided, houses were built and land clearing and livestock rates increased. The understorey of these blocks is now predominantly pasture.

Recent years have seen a spate of dry autumns and wet winters. These conditions favour population booms of defoliant insects such as psyllids and Gum-leaf Skeletonisers. Stress from habitat fragmentation, insectivorous bird decline and foliage dieback, drainage alteration and ringbarking by livestock has resulted in the death of many mature trees. Surviving paddock trees inevitably fail to flower prolifically or to attract the honeyeaters and lorikeets.

Recent decline and likely loss of several rare species. Several species must be regarded as being close to local extinction. These include:

- Whistling Kite: several pair prior to 1986; now a rare visitor
- Brush Cuckoo, Azure Kingfisher and Cicadabird: sightings each of only 1 bird since 1986
- Bassian Thrush: former breeding resident; seen as single birds in recent years
- Brown Treecreeper: the breeding colony at Janefield south spur was last seen in 1989; the only other recent sighting was of one bird near Dry Quarry in December 1990
- Painted Honeyeater: stands of Yellow Gum box-ironbark woodland in the Oatland Road area which contained nesting birds in the 1970s have been cleared
- Platypus: small population; possibly no longer breeding due to water pollution

- White's Skink: populations under Yellow Box–Hill Manna Gum grassy woodland above the western escarpment of the river are now mostly near housing
- Red-bellied Black Snake: eliminated from the volcanic plains west of the gorge by housing; seen elsewhere only at Dry Quarry
- Freshwater Blackfish: last recorded in 1970s, have apparently been eliminated.

Housing development

The hazard for nature conservation and its management that housing development presents in this site is unparalleled in NEM. The establishment of housing at Blossom Park immediately abutting the western escarpment has been poor conservation planning. It has received much criticism over recent years from local conservation groups and scientists. A major problem has been the inadequacy or lack of retarding basins at the head of gullies to contain the urban runoff. One gully (Fissidens Gully on R&D) which supports very rare and sensitive aquatic mosses has no protection from polluted runoff from South Morang. Other issues such as erosion, weed invasion, habitat degradation and declining water quality in the river fail to be addressed.

Human impact on the western river escarpment. Past management at Janefield and the future impact of development at Blossom Park will render difficulties for effective or efficient conservation management. Much cost in labour and resources will be needed to restore these sections. Soil disturbance through motor bikes (etc.) and rubbish dumping on vacant land immediately west of the park continues to increase.

Faunal movement bottleneck—inadequate fire break and conservation buffer. The lack of width between the river and the housing has placed a bottleneck for fauna movement along the gorge. Houses adjacent to the gorge in medium density residential development at Blossom Park back onto a slashed firebreak strip. A predator fence between the housing and the gorge is being established. Many sections still lack a fence, and intruder entry from the housing development is a major conservation hazard.

Rear-facing houses and the downhill slide of the gorge environment. The loss of visual contact by rear-facing houses and high wooden fences provides a low aesthetic appeal and encourages residents to use it as a 'backyard'. Consequently, unseen to the public, garden clippings and other rubbish are constantly dumped there. Plants such as English Couch, Wandering Jew and English Ivy are replacing the native grasslands on the river escarpment. With the rank growth, other weeds and vermin follow, particularly Black Rats, slugs and snails. The slugs are eliminating greenhood orchids on the escarpment. The ivy is strangling Manna Gums, and in combination with dieback from high Bell Miner populations caused by forest fragmentation, is killing weakened and ageing trees. These trees fail to regenerate after bushfire, which is also an increasing threat from the adjacent development.

Uncontrolled levels of disturbance arising from Blossom Park. Uncontrolled human, dog and trail bike access is available. The vegetation has become trampled and degraded and the biological values of the gorge escarpment (containing significant volcanic plains grassland and shrubland) is rapidly declining. The rate of habitat degradation and disturbance caused by intruders is escalating. There is a high rate of entry into the Blue Lake area from the opposite side of the river at Blossom Park. Vandalism to park property has occurred.

Declining Black Wallabies. Dog and human disturbance arising from the Blossom Park development have displaced the Black Wallabies (one of the more obvious species, but likely many others) to more remote sections on the east side of the river. Roaming dogs and people with unrestrained dogs are frequently seen. On several occasions, dogs chasing wallabies and dead animals that have been shot by a gun or arrow have been encountered. The small population of wallabies on the Plenty side of the river has dwindled and may be eliminated over the next few years. They are already partially isolated from populations upstream. If any future development or rezoning of the minimum allotment size to allow subdivision transpires on the east side, the wallabies and many other ground fauna species will almost certainly be eliminated from the southern end of the gorge.

Effects of cats on native wildlife. Domestic cats from the housing estates and dumped or stray cats from elsewhere roam the gorge causing losses amongst native wildlife species. Feral cat populations occur throughout the gorge. The toll on native birds and small mammals would be high. See Volume 1.

Alien bird advance into gorge with adjacent residential development. The eventual elimination of the Bassian Thrush from the Plenty–Janefield site would be attributable to predation from cats and competition from the increasing alien bird populations such as the related Common Blackbird and Song Thrush. The populations of these birds and that of the Spotted Turtle-Dove, Common Myna and Common Starling have dramatically risen and they now dominate near urban sections of the gorge.

Planning Recommendations

Plenty–Janefield Ecological Reference Area (ERA). The most critical requirement is the protection of the Yellow Gum box–stringybark woodland. Sections of proposed ERA on the east side of the Plenty river include: the river and the Janefield bushland from the Bell property boundary to Janefield Mine including the Satyrinid Gully and Janefield Spur; the Blue Lake–Dry Quarry block; the Goldsworthy Lane Yellow Gum block; and the Ivanhoe Girls Grammar School and Memorial Drive spur block. Sections on the west side of the river include: the western escarpment from Janefield South to Blossom Park; the Pteris Gully and the whole of the R&D Estate from Pteris Gully, including Fissidens Gully and pipetrack area to the Transmission Line. The key biological/research areas of the ERA are Satyrinid Gully, Janefield Spur, Memorial Drive spur and the Quaternary volcanics, Fissidens Gully and Pilularia Swamp of R&D.

The ERA requires restricted public access conditions and nature conservation of all native habitat and potential native habitat to be the principal planning/land-use priorities. The ERA encompasses land in the Plenty Gorge Park and PPOS and contains specific conservation and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). A buffer zone is provided by surrounding land in the Plenty Gorge Park. The negotiation of conservation covenants or similar conservation agreements as to the management of adjacent freehold bushland (particularly PPOS) would be desirable. A predator/human fence will be required on the western side of the river to isolate the ERA from residential or proposed residential areas. An open space buffer area should lie between the fence and residential areas.

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the ERA include:

- River spurs. Yellow Gum–Red Box box–ironbark woodland (12.3): lorikeet assemblage, Swift Parrot, Painted Honeyeater, Lycaenid butterfly assemblage (particularly the Genoveva Azure, Large Ant-blue, Fiery Jewel and Icilius Blue) and orchid assemblage.
- Tertiary river alluvium. Hill Manna Gum/Burgan sand-plain woodland (15.1/15.2): Barking Owl, Lycaenid butterfly assemblage (particularly the Ictinus Blue).
- Quaternary volcanic stony plains and cliffs and Tertiary volcanic cappings. River Red Gum grassy woodland (14.1), Yellow Box–Hill Manna Gum grassy woodland (14.2) and Lightwood–Tree Violet cliff/escarpment shrubland (20.5): volcanic plains herpetofauna assemblage.
- Satyrinid, Pteris and Fissidens Gullies. Manna Gum gully woodland (10.1). Mazus Valley. Swamp Gum gully woodland (10.3): butterfly assemblages (particularly skippers and browns) and gully flora (particularly the bog plants of Mazus Valley and mosses of Fissidens Gully).
- Sedimentary river escarpments and cliffs. Long-leaf Box–Manna Gum, Yellow Box and Red Box escarpment woodland (13.1/13.2/13.3) and Burgan–Sweet Bursaria and Golden Wattle cliff/escarpment shrubland (20.2/20.4): reptile, bird and rare or threatened plant assemblages.
- River gorge—pools, terraces and rapids. Manna Gum floodplain riparian woodland (16.4/16.5) and Muttonwood riparian scrub (18.1): migratory insectivores, Rainbow Bee-eater, Barking Owl and prey assemblages (including the Sugar Glider) and Platypus.
- Floodplain wetland. Tall Sedge–Soft Bog-sedge seasonal wetland of the Pilularia Swamp: rare/disjunct swamp flora.

Supportive categories in the ERA include:

Janefield Gold Mine: Common Bent-wing Bat.

Development and extension of the Plenty Gorge Park as outlined in the RL 111 plan. The park is a vital link in the ‘green web’ initiative.

Site 43 Tanunda Wetlands

- Map Reference:** 7922 306284. One minute lat/long grids include 37° 40' x 145° 04'.
- Location/Size:** Tanunda Wetlands at Blossom Park and Pteris Gully to the north and surrounding low-lying open space. Approximately 100 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: Plenty Gorge Park (Melbourne Parks & Waterways). Formerly part of Pioneer/Readymix quarries. The Janefield Training Centre lies to the south and residential areas of Blossom Park lie to the west and north.
- Landforms:** Foothill and alluvial plain (see PLH A). Elevation is 70 m.

Scientific and Educational Values

Rehabilitation and management. Extensive remodelling and revegetation works are being undertaken

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Relatively intact and extensive stands: Manna Gum gully woodland (10.1; Pteris Gully at Blossom Park); Long-leaf Box—Manna Gum escarpment woodland (13.1; Pteris Gully); Common Reed—Cumbungi—Tall Spike-sedge seasonal wetland (25.7; Tanunda Wetlands)

Critical assemblages or populations: Pteris Gully forms part of the Plenty—Janefield Ecological Reference Area.

Notable features: Establishing Common Reed—Cumbungi seasonal wetland (25.7) and Blunt Pondweed—Lake Eel-grass permanent wetland (26.1) at Tanunda Wetlands. Extensive wetland development and revegetation work is being undertaken

FAUNAL SIGNIFICANCE: Site 43 Tanunda Wetlands

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

43^a: 37° 40' x 145° 04'; Plenty Gorge Park—Tanunda Wetlands/Blossom Park

A. Cited Zoological Significance

Regional. Beardsell (1989). **Local.** Biosis (1991)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 43^a: Blue-billed Duck

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 43^a: 20 species on 22 March 1991

d. Breeding waterfowl

Regional. 43^a: 6 species on 7 November 1991

k. Frogs

Regional. 43^a: 7 species on 7 November 1991

l. Reptiles

Local. 43^a: 5 species on 7 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Local. 43^a: 70 species (fails on mammals)

b. Native birds

Regional. 43^a: 57 species

c. Native mammals

Local. 43^a: 1 species (Eastern Grey Kangaroo)

d. Herpetofauna

Regional. 43^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 43^a: 8 species

c. Regionally vulnerable fauna (R2 species)

Regional. 43^a: 2 species. **Birds:** Little Egret, Spotted Harrier

d. Regionally rare fauna (R3 species)

Regional. 43^a: 6 species. **Birds:** Australian Spotted Crake, Great Crested Grebe, Darter, Blue-billed Duck, Australasian Shoveler, Musk Duck

f. Regionally restricted fauna (R5 species)

Regional. 43^a: 1 species. **Birds:** Australian Pelican, Royal Spoonbill, Great Egret, Cattle Egret, Rainbow Lorikeet. **Reptiles:** Common Long-necked Tortoise, Tussock Skink. **Frogs:** Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

c. Waterfowl

Regional. 43^a: over 200 on 22 March 1991

f. Frogs

Regional. 43^a: over 100 Growling Grass Frogs and 100 Common Bullfrogs on 7 November 1991

g. Rare/restricted colonial fauna

Regional. 43^a: small roosting colony of Darters (usually a pair) present in March and November 1991. **Local. 43^a:** 37 cormorants of 3 species in March 1991

m. Regionally rare fauna (R3 species)

Regional. 43^a: 30 Hardheads on 7 November 1991; 55 in mid-June 1992

o. Regionally restricted fauna (R5 species)

Regional. 43^a: 50 Cattle Egrets roosting in April 1993 amongst trampled Cumbungi on the south side of the main wetland

Outlook

Wetland development will raise the faunal significance, particularly for breeding waterfowl and cover-dependent waterbirds such as Latham's Snipe, rails and crakes.

FAUNA

Rare or Threatened Fauna

Bc 43^a: Blue-billed Duck. A pair were present on the southern lake on each of two waterbird counts made at Tanunda Wetlands (22 March 1991 and 7 November 1991). They probably breed amongst the dense cumbungi, though this has not been confirmed.

Other Significant Fauna

Birds

Cb/Fc **43^a: Waterbirds at Tanunda Wetlands.** The combined wetland area is about 8 ha. Thirty three species have been observed. On the waterbird count of 22 March 1991, 200 of 20 species were present. This included 30 cormorants (3 species) and a pair of Darter, which were roosting in the flooded trees at the west end of the southern lake (feed mainly on Goldfish). If human visitation rates could be reduced in spring, the Darters may breed. A pair of Pink-eared Duck was seen on the open water and a single Australian Spotted Crake flushed from the edge of the outlet channel into a Cumbungi bed in March 1991. The large number of resident waterfowl on the lake is influenced by the dominance of the submerged meadow.

The Little Egret and Australian Pelican were seen in 1990 and 55 Hardheads were present in mid-June 1992 (Mark Tscharke pers. comm.). A pair of Great Crested Grebe was seen on the lake in December 1992 (Alan Webster pers. comm.) and a single bird in full breeding plumage was seen in January 1993 (Mark Tscharke pers. comm.). They may have bred amongst the cumbungi. A Cattle Egret roost of up to 50 birds formed amongst trampled Cumbungi on the south side of the main wetland in April 1993 (Mark Tscharke pers. comm.).

Ec **43^a: Spotted Harrier.** A pair was present at Tanunda Wetlands from late February to mid-April 1995 (Mark Tscharke pers. comm.). Spotted Harriers moved into NEM at this time as a result of the inland drought of 1994. It is unknown whether they bred locally. The main prey of the Tanunda birds was the rabbit, taken while hunting over the surrounding grassland.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. The site lies adjacent to the Plenty–Janefield site. It forms an integral part of the important wetland complex of the Plenty Gorge.</p>	
Regional Hydrological Strategy	
<p>Disturbance to waterbirds from humans (see Yarrambat–Morang Wetlands site).</p>	
<p>Mosquito Fish. Their introduction into the lake appears relatively recent. Frogs such as the <i>Litoria</i> and <i>Limnodynastes</i> which have floating egg masses upon which the Mosquito Fish predate, are declining. Mosquito Fish, Goldfish and Redfin (if present) may limit the potential of successful establishment of native fish such as the Southern Pigmy Perch and Freshwater Blackfish.</p>	<p>Tanunda Wetlands remodelling and revegetation works. The north-eastern outlet contains a wide channel lined with Cumbungi. The channel passes through a low-lying gravel pit area before entering the Plenty River. A shallow wetland and lagoon system was developed in this area in early 1992. Tall Spike-sedge and other emergent species have been established. This wetland will provide habitat for Latham’s Snipe and crakes and rails and possibly breeding areas for waterfowl such as the Australasian Shoveler, Hardhead and Blue-billed Duck. When fully established, access should remain restricted. The area of quarry spoil and wasteland directly west of the outlet channel was developed into a retardation and filtration pond system for stormwater from Blossom Park. The presence of humans near the wetlands disturbs waterbirds and should be avoided until such time as effective screening vegetation or bird hides are established.</p>

PLH B GREENSBOROUGH

This management unit consists of one site of state faunal significance (site 44) and one site of regional faunal significance (site 45) and surrounding land that forms habitat links.

Map Reference: 7922 334233 to 7922 323267 (Plenty River); 7922 337258 (Yandell Reserve); 7922 343266 (Brown's Reserve on Albion Crescent).

Location/Size: Lower reaches and catchments of the Plenty River from Yallambie to Greensborough. Approximately 190 ha.

Municipality: City of Banyule and Shire of Nillumbik. (small section upstream of Greensborough Bypass)

Physical Features

The management unit lies in the foothills of the Eastern Uplands and includes the lower reaches of the Plenty River. Adjoining downstream of unit are the Plenty Flats of the Yarra Lowland Alluvial Plains. Upstream lies the Plenty Gorge. The predominantly sandstone hill country (Plenty Lowland Hills) of the unit flattens to the west as it meets the Plenty Volcanic Plains and steepens to the east as it meets the siltstone foothills (Nillumbik Lowland Hills). The Plenty River has developed a narrow floodplain, constricted in sections between parallel lines of north-south hills and spreading out at the confluence of streams. Some colluvial outwash deposits have developed in the broad valleys and hill-slopes that occur along the eastern tributaries.

Landforms

Foothill: hill-crests, hill-slopes, valleys, gullies and creeks. Alluvial/volcanic plain: volcanic cappings, sand-plains, plain-slopes (Yallambie to Watsonia), creeks and river/floodplain. The river pools are deep (about 4 m) and contain submerged logs, emergent snags and mudbars. The low banks of the river adjoin alluvial terraces. Elevation is 30–120 m.

Hydrology

The Plenty River meanders through the low foothills downstream of the Plenty Gorge and upstream of the Plenty Flats at the confluence of the Yarra River. The banks on the low meanders are 1 to 2 m high but the river seldom floods beyond them onto the broad floodplain terraces. The Plenty River is a perennial, slow-moving stream. The unit falls entirely within the urban area and the river has assumed the characteristics of an urban stream (i.e. functioning as a drain for moderately polluted urban runoff and supporting degraded native vegetation). Gullies feed perennial urban runoff into the river. In their natural condition they were probably ephemeral as their catchments are local.

Rainfall: 650–700 mm.

Site 44 Greenhills

- Map Reference:** 7922 337258 (Yandell Reserve); 7922 337260 (Keswick Glen Reserve); 7922 343266 (Brown's Reserve on Albion Crescent). One minute lat/long grids include 37° 41' x 145° 07'.
- Location/Size:** Urban bushland between Diamond Creek Road and St Helena Road Greenhills. Approximately 40 ha.
- Municipality:** City of Banyule
- Land Tenure/Use:** Public: municipal reserves (Yandell Reserve, Keswick Glen Reserve and Brown's Reserve). Private: residential blocks. The reserves are managed as public open space.
- Landforms:** Foothill (see PLH B). Elevation is 60–100 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Yellow Gum box–ironbark woodland (12.3)

Critical assemblages or populations: Sweet Bursaria habitat of the Eltham Copper butterfly

Notable features: remnant eucalypts (Yellow Box–Red Stringybark box–stringybark woodland; 11.2 and Yellow Gum–Red Box box–ironbark woodland; 12.3) in the Greenhills residential area surrounding Yandell Reserve form important habitat for parrots (notably Swift Parrots)

FAUNAL SIGNIFICANCE: Site 44 Greenhills

Assessment: State—Category 3 (B, F); Regional (B, D, E, F)

Reference grids for the significance keys include:

44^a: 37° 41' x 145° 07'; Yandell Reserve, Greenhills

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 44^a: Eltham Copper butterfly colony at Yandell Reserve; a larva was also located at Keswick Glen Reserve on 23 June 1992

b. Vulnerable fauna

Regional. 44^a: Swift Parrot—a pair feeding in flowering Yellow Gums at Keswick Glen Reserve on 23 June 1992

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 44^a: 4 species: Fan-tailed Cuckoo, Rufous Whistler, Black-faced Cuckoo-shrike and Olive-backed Oriole at Yandell Reserve on 3 November 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Local. 44^a: over 50 species (fails on mammals/herpetofauna)

b. Native birds

Regional. 44^a: over 50 species

c. Native mammals

Local. 44^a: 3 species including the Sugar Glider

d. Herpetofauna

Local. 44^a: 5 species including the Bougainville's Skink and Ewing's Tree Frog

f. Butterflies

Regional. 44^a: 22 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 44^a: 3 species

b. Regionally endangered fauna (R1 species)

Regional. 44^a: 1 species. **Butterflies:** Eltham Copper

e. Regionally depleted fauna (R4 species)

Regional. 44^a: 2 species. **Birds:** Swift Parrot. **Butterflies:** Blue Jewel

f. Regionally restricted fauna (R5 species)

Local. 44^a: 7 species. **Birds:** Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, White-winged Chough (August 1990 at Albion Crescent; now locally extinct due to surrounding subdivision). **Reptiles:** Bougainville's Skink. **Butterflies:** Spotted Skipper, Phigalia Skipper

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 44^a: Eltham Copper butterfly—dwindling population of fewer than 50 individuals at Yandell Reserve

Local. 44^a: 2 Swift Parrots at Keswick Glen Reserve on 23 June 1992

e. Honeyeaters/lorikeets

Regional. 44^a: 23 lorikeets of four species in flowering Yellow Gums at Keswick Glen Reserve on 23 June 1992. These included 12 Rainbow Lorikeets, 8 Musk Lorikeets, 2 Purple-crowned Lorikeets and 1 Little Lorikeet

Outlook

The faunal significance, particularly the ground fauna and forest birds, has declined markedly over the last decade and will continue to decline unless intensive habitat rehabilitation programs and restoration of habitat links are undertaken.

FAUNA

Rare or Threatened Fauna

Ba 44^a: Eltham Copper butterfly. Colony at Yandell Reserve and a small colony at Keswick Glen Reserve.

Bb 44^a: Swift Parrot. A pair was seen feeding in flowering Yellow Gums at Keswick Glen Reserve on 23 June 1992. As winter proceeds and the Yellow Gums reach full flowering, larger numbers of Swift Parrots and the Little, Musk and Purple-crowned Lorikeets visit from nearby feeding grounds at Plenty–Janefield.

Critical Assemblages or Populations

Fb 44^a: Eltham Copper butterfly. A flight season population count was conducted at Yandell Reserve on 20 December 1992. Nine adults were counted in a 20-minute transect search. These were flushed by gently tapping the shrubs. The detection rate of the total adult population at any one time is unknown. Under systematic searching when conditions are optimal in the mid-flight season, it is surmised to be of the order of 50%; hence a tentative adult population of 20. Nineteen bursaria plants were being grazed with 38 larvae counted (averaging two larvae per plant) on an evening visit in October 1992. Similar to the adult survey, sampling technique is surmised to record about 50% of the total population (i.e. some still underground or on unsurveyed bushes). The larval count/single flight count ratio of about four larvae per adult is consistent with data from surveys at the Eltham Copper Butterfly Reserves (van Praagh 1996).

Other Significant Fauna

Birds

44^a: Refuge for several nocturnal bushland bird species in urban Greensborough. These include the Australian Owlet-nightjar, Tawny Frogmouth and Southern Boobook. Apart from possibly along the Plenty River, the nightjar is absent from elsewhere in urban Greensborough.

44^a: Breeding bushland birds and winter visitors from the ranges. A third of the resident and migratory bird species breeding in the reserves have small and diminishing populations. These include the Common Bronzewing, Brown Goshawk, Fan-tailed Cuckoo (spring migrant), Eastern Yellow Robin, Golden Whistler, Rufous Whistler (spring migrant), Weebill, Buff-rumped Thornbill, Spotted Pardalote, White-naped Honeyeater, Yellow-faced Honeyeater, Olive-backed Oriole, Grey Currawong and Australian Raven. These species move locally into residential Greensborough. Winter influxes of non-breeding upland species include the Gang-gang Cockatoo, Yellow-tailed Black-Cockatoo, Crimson Rosella, Pied Currawong and Scarlet Robin. Some of these are signature birds of the bushland remnants at Greenhills.

Mammals

44^a: Sugar Glider. One was seen leaving a spout in a large Yellow Gum in Keswick Glen Reserve. The hollow limbs of the mature gums at Greenhills provide nest sites for parrots, owls and the Sugar Glider. Sugar Gliders were not recorded elsewhere in urban Greensborough. They require operative habitat links. The retention and planting of trees linking through the residential area to the bushland reserves at Greenhills is critical for the survival of the local population. Reduced predation pressure from cats may determine their survival.

Butterflies

44^a: Yandell Reserve. Twenty two species including a colony of the endangered Eltham Copper were recorded. Prior to land settlement, the copper was probably widespread on the sandstone hill-crests between Greenhills and Montmorency. Other locally threatened species include the Donnysa Skipper, Spotted Skipper, Phigalia Skipper and Blue Jewel. The larval food-plant of the Donnysa and Spotted Skipper is Thatch Saw-sedge. This occurs on the lower sheltered slopes of Yandell Reserve. These skippers are seldom recorded in the urban area. The lower slopes of Yandell Reserve have become weed invaded and the long-term prospect for survival of the skippers is poor. Despite the degraded nature of the habitat and small size of the reserve, it still supports a relatively diverse butterfly assemblage. This is of equal diversity to that recorded for Gresswell Hill at Mont Park and is significant in the context of the urban area.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective habitat links are present. A fragmented gully woodland (10.1) link extends from the front of Yandell Reserve along St Helena Road to join the Plenty River at Pioneer Reserve. The remnant eucalypts (Yellow Box–Red Stringybark box–stringybark woodland; 11.2 and Yellow Gum–Red Box box–ironbark woodland; 12.3) on the larger houseblocks north-east of Yandell Reserve connect bushland at Albion Crescent and then south-east via Karingal Drive and residential parts of Eltham North to Meruka Park and the Diamond Creek at Eltham township.</p>	
<p>Severance of habitat links and habitat degradation. Many of the specialised native ground flora and fauna, including species of orchids and butterflies, have died out in recent decades due to habitat fragmentation and disturbance. Extensive stands of Yellow Box–Red Stringybark box–stringybark woodland (11.2) and Yellow Gum–Red Box box–ironbark woodland (12.3) remained at Greenhills until the onset of modern development in the late 1960s. This extended north-west to Plenty–Janefield in the Plenty Gorge. Red Stringybark herb-rich foothill forest (6.1) extended east through the more hilly rural/bushland areas of St Helena and Eltham, where it co-occurred with Red Box–Red Stringybark box–stringybark woodland (11.1).</p> <p>While the trees in the site are still significant for some hollow-nesting and nectar-feeding birds (e.g. lorikeets), human pressures have made the area no longer significant for orchids and most native ground fauna species. The adequacy of reserves and open space to maintain viable populations of these species must be taken into account when planning future urban growth in the Shire of Nillumbik. The scenario for extinction of most of this biota, as has already occurred in the City of Banyule, is set throughout the inner section of the Shire.</p> <p>Eucalyptus dieback. Dieback of mature Yellow Box, Narrow-leaf Peppermints and Swamp Gums has been hastened by the large populations of Noisy Miners present. These birds drive out foliage insectivores such as the Spotted Pardalote which control defoliating insect populations. The primary cause of this imbalance is the inadequate size and connectivity of the woodland remnants.</p>	<p>Improve habitat links. A system of functional links to the Plenty River, Albion Crescent (Brown’s Reserve) and Meruka Park should be developed.</p> <p>The long-term survival of the Sugar Gliders and Tawny Frogmouths will require effective links to all of the currently isolated stands of trees. This will also reduce the rate of eucalyptus dieback by promoting the movement of forest insectivores into the site through the intervening residential areas between the Plenty Gorge and Diamond Creek.</p>

Decline of the Eltham Copper butterfly. The statewide decline is attributed to extensive habitat loss through agriculture and urbanisation (Braby *et al.* 1992). In the early 1950s the site supported extensive areas of the appropriate food-plant (Sweet Bursaria) of the Eltham Copper. The butterfly was still regarded as 'common' at Greensborough in 1958 (Braby *et al.* 1992). At this time the exposed Silurian sandstone hill-crest and hill-slopes (Yellow Box–Red Stringybark box–stringybark woodland; 11.2) to the south of St Helena Road between Mountain View Road and the Plenty River David Crosby pers. comm.) held a large colony of the butterfly.

Until the discovery of the colony at Yandell Reserve in 1987, the butterfly was thought locally extinct. Prior to this discovery, the population had been cut in two by a road and encircled by housing. The colony is the last known to remain in the catchment of the Plenty River and one of only six known to remain in Greater Melbourne (all in NEM). Each of these populations is now isolated by residential development. The species must be regarded as under threat of regional extinction.

Conservation management plan required for the Eltham Copper butterfly at Yandell and Keswick Glen Reserves. The protection and enhancement of fauna and faunal habitats (particularly the endangered Eltham Copper butterfly) must be addressed.

Upgrade parkland status to a conservation area and conservation management of Yandell and Keswick Glen Reserve. This should be undertaken as both reserves contain the Eltham Copper butterfly. Nature conservation should be the priority land-use in the reserves.

Other Issues

Orchid decline associated with habitat loss, weeds and trampling. Twenty species were recorded at Yandell and Keswick Glen Reserves in 1988. Surveys reveal that six were eliminated between 1988 and 1992. Each of the surviving 14 species is threatened by weed invasion and trampling. Most are vegetative colony formers or self-pollinating species which are often the last orchids to persist in disturbed environments. The most significant of these are the Trim Greenhood and Rusty-hood, but only a few plants persist. Both Yandell Reserve and Keswick Glen Reserve have chronic weed problems, particularly Montpellier Broom, Flax-leaf Broom, Boneseed, Annual Veldt Grass, Panic Veldt Grass and Large Quaking-grass. Unless intensively managed, the trampling, weeds and associated slugs and snails will eliminate the remaining orchid populations.

Community 'friends' group required for planting and weed control. As evidenced by trampling and litter, Yandell and Keswick Glen Reserves are heavily used for recreation by locals. Habitat degradation is noticeably increasing. The formation of a local friends group is needed to address this issue. The work of the group should focus on the reserves and their role as the nodes for indigenous flora and fauna populations at Greenhills. Priority habitat works should include weed control (commencing with Montpellier Broom, Boneseed and the alien grasses).

Loss of tree hollows. Hollow limb fall near houses is leading residents to remove overhanging trees. The hollows provide homes for several important hollow-dependent species including parrots, the Sugar Glider and bats.

Recreational pressure on local open space is threatening the flora and fauna. There is a shortage of open space in Greenhills. Yandell and Keswick Glen Reserves are heavily used for recreational purposes by locals. This has impacted on the bushland. Keswick Glen Reserve contains no formal tracks and the entire area has become trampled and degraded by weeds. The existing fencing at Yandell Reserve is an ineffective deterrent to entry into the wildflower/butterfly patches. Most orchids are trampled before they flower. The Cairns Street verge at the north end of Yandell Reserve contains significant vegetation, particularly the Sweet Bursaria and Trim Greenhood. The area is being trampled by pedestrian traffic.

Public interpretation. A nature education interpretations program should be targeted at the local community. Yandell Reserve has potential for the establishment of a nature trail system. The local community needs to be made aware of the presence of the Eltham Copper. Damage from trampling in the butterfly and orchid areas would be reduced through raising local awareness of the significance of the reserves for the Eltham Copper. Cats prey on species such as the Sugar Glider. Education and controls to restrict cat wanderings will be required if the Sugar Glider is to survive.

Effective fencing of significant wildflower and butterfly areas. The remnant orchid and Eltham Copper areas at both reserves are being trampled. The public can easily enter the fenced-off wildflower/butterfly section at Yandell Reserve. More effective internal fencing is required. Revegetation areas are needed. The Cairns Street verge at the north end of Yandell Reserve should be closed to pedestrian access.

Threats to the Eltham Copper butterfly. The overall area of habitat of the butterfly at Greenhills is diminishing and may be reaching a critically low level. The colony has dwindled to fewer than 50 individuals. There are several contributing reasons for the decline. These include: habitat loss and fragmentation of habitat links by residential development; inadequate size and buffering of the habitat patches from disturbance in adjacent residential areas; and habitat degradation within the colony area due to pressure from public usage (see Eltham Copper Butterfly Reserves site). The adult population has dwindled to fewer than 20 individuals. Specific threats to the butterflies at Yandell Reserve and Keswick Glen Reserve include weed and alien invertebrate invasion, elimination and degradation of native shrub and field layer vegetation (particularly the Sweet Bursaria) and changing environmental and ecological parameters operating on the butterfly and its larval food-plant and host ant. This has been contributed to by mowing, trampling, rubbish dumping (e.g. garden clippings) and removal of logs. Specimen taking by butterfly collectors is likely to occur. Without intensive management and protection the long-term survival of the butterfly in the site is poor. Loss of habitat links connecting to other colonies has made the Yandell Reserve colony susceptible to elimination by collectors and chance effects such as fire.

The alien grass invasion and is likely altering drainage/soil moisture and nutrient conditions. Many of the ant nests not containing butterfly larvae appear damp. Large populations of alien invertebrates (e.g. slugs, snails and millipedes) are present and doubtless, have an effect. The long-term ecological requirements of the butterfly colonies would include the ability to move locally and colonise new areas, particularly if site conditions change (e.g. growth pattern of the bursaria, degree of dampness or shading etc.). The lack of surrounding colonisable habitat may be the ultimate limiting factor to the survival of all the Eltham Copper colonies.

Site 45 Yallambie to Greensborough

Map Reference:	7922 333233 (Plenty River). One minute lat/long grids include 37° 41' x 145° 05' to 145° 06' and 37° 42' x 145° 05' to 145° 06'.
Location/Size:	Approximately 130 ha.
Municipality:	City of Banyule and Shire of Nillumbik. (small section upstream of Greensborough Bypass)
Land Tenure/Use:	Public: open space and parkland along the Plenty River (City of Banyule/Shire of Nillumbik). Private: residential.
Landforms:	Foothill and alluvial plain (see PLH B). Elevation is 35–80 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 3

Partially intact or small stands: Manna Gum (riverbank) floodplain riparian woodland (16.4)

Notable features: river Manna Gum nest trees (notably Rainbow Lorikeets)

FAUNAL SIGNIFICANCE: Site 45 Yallambie to Greensborough

Assessment: Regional—Category 2 (B, D, E)

Reference grids for the significance keys include:

45^a: 37° 41' x 145° 05'; Plenty River–Apollo Parkways/Corowa Crescent

45^b: 37° 42' x 145° 06'; Plenty River–Greensborough to Montmorency

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 45^a: Swift Parrot—flying over Apollo Parkways in autumn 1990; a flock of about 300 seen at dusk on one occasion heading south-east from Janefield over Greenhills

Regional. 45^b: Swift Parrot—several feeding in Yellow Box at Alexandra Street, off Para Road in winter 1991

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

m. Freshwater fish

Local. 45^b: only one native species (one Short-finned Eel) electrofished from the Plenty River at Montmorency Park on 16 December 1988; 300 Roach were taken

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 45^a: 78 species between Apollo Parkways and Corowa Crescent on the Plenty River

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 45^a: 4 species. **45^b:** 4 species

c. Regionally vulnerable fauna (R2 species)

Regional. 45^b: 1 species. **Birds:** Little Egret (Para Road/Montmorency Park)

d. Regionally rare fauna (R3 species)

Regional. 45^a: 2 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift (overhead)

Regional. 45^b: 1 species. **Birds:** Fork-tailed Swift (overhead) at Para Road/Montmorency Park in 1990

e. Regionally depleted fauna (R4 species)

Regional. 45^a: 2 species. **Birds:** Australian King-Parrot, Swift Parrot

Regional. 45^b: 2 species. **Birds:** Swamp Harrier, Swift Parrot

f. Regionally restricted fauna (R5 species)

Regional. 45^a: 10 species. **Birds:** Cattle Egret, Great Egret, Nankeen Night Heron, Australian Shelduck, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella

Local. 45^b: 5 species. **Birds:** Cattle Egret, Little Eagle, Australian Hobby, Rainbow Lorikeet, Little Lorikeet

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

Local. 45^a: Nankeen Night Heron seen on several occasions along the Plenty River upstream of the Greensborough By-pass/possible roosting colony

Outlook

The faunal significance has declined and meets only six sub-criteria at the Regional level. It is the weak habitat link along the lower Plenty River and is inhibiting faunal movement between the Plenty Gorge and the Yarra River. Habitat rehabilitation and revegetation and land protection works in the Yallambie to Greensborough site will assist fauna in these areas.

FAUNA

Rare or Threatened Fauna

Bb 45^{ab}: **Swift Parrots and remnant Yellow Box in urban Greensborough.** Swift Parrots are frequently seen in the surrounding suburbs that support remnant trees (generally on or near streams). Suburban Greensborough is probably the most important of these. In these situations the parrot has been recorded feeding on flower buds, nectar or leaf psyllids taken from Swamp Gum, Manna Gum, Yellow Box and River Red Gum. In 1991, small flocks were seen over a period of several weeks in late autumn-early winter feeding in a large roadside Yellow Box in Alexandra Street, about 500 m from the Plenty River (David Baker-Gabb pers. comm.). The tree was not flowering and the birds would have either been feeding on leaf psyllids or flower buds (or both). Swift Parrots are rarely seen in suburbs lacking mature indigenous trees.

Other Significant Fauna

Freshwater fish

45^b: Electrofishing Survey: Plenty River—off Para Road at Montmorency Park

Map reference. 7922 335237. **Altitude.** 30 m. **Survey date.** 16 December 1988

Vegetation. Instream: emergent herbfield. Bank: Manna Gum (riverbank) floodplain riparian woodland (16.4; poor condition; weed invaded). Frontage: Yellow Box–Red Stringybark box–stringybark woodland (11.2; remnant); Yellow Box–Candlebark grassy woodland (14.6; remnant); Manna Gum (terrace) floodplain riparian woodland (16.5; playing fields)

Physical Features:

Pools

Substrate. Anaerobic silt, concrete blocks and rubble, cobbles and urban rubbish on sheet siltstone

Maximum size (mid-summer). 6 m wide by 1.0 m deep by 400 m long

Riffles

Substrate. Silt, gravel and cobbles on sheet sandstone

Flow (summer urban): Size. 6.0 m wide by 20 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 57 ML/day.
About 50% fed from urban runoff

Water quality

Summer: Temperature. 20°C. **Conductivity.** 600 ms. **Turbidity.** Very high

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (1); migratory sub-adult

Alien species numbers/status. Roach (300); likely breeding resident. Weather Loach (2); likely breeding resident.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Partially intact riparian habitat links upstream to the Plenty–Janefield site and downstream to the Plenty River Flats site.

Green web park. All public lands along the Plenty River linking the Yarra River to the Plenty Gorge should be incorporated into a green web park. This should be embraced under the Open Space 2000 initiative. See site 46.

Loss of habitat links and bush birds. The Plenty River still functions as a habitat link for waterbirds and larger forest birds such as the Grey and Pied Currawong, Gang-gang Cockatoo and Yellow-tailed Black-Cockatoo. This is the only site in NEM in which no regionally threatened, rare or depleted passerine birds (e.g. thornbills, honeyeaters, flycatchers etc.) were recorded. Most of the small birds present are those which have adapted to urban bushland areas (e.g. Superb Fairy-wren, Grey Fantail, White-browed Scrubwren, Silvereye and White-plumed Honeyeater).

Strengthen habitat links. The Plenty River is a very important habitat link in the Shire of Nillumbik and City of Banyule. The site is the ‘weak’ link between the Plenty Gorge and the Yarra River. Movements of the endangered Regent Honeyeater between the Plenty Gorge and the Yarra River may be dependent on the link. The Manna Gums and Yellow Box along the river are important feeding habitat for the Swift Parrot and breeding habitat for the Rainbow Lorikeet. Habitat enhancement and protection works are essential to turn around the present rate of fragmentation and depletion of native fauna populations. These works should be integrated with conservation programs upstream in the Plenty Gorge. A management plan for enhancing the link is required.

Protection of the remnant Yellow Box of suburban Greensborough. Steps must be taken by the councils in the Shire of Nillumbik and the City of Banyule to adequately protect all mature, indigenous trees in suburban gardens, streets and parklands within and adjacent to the site.

 Regional Hydrological Strategy

River pollution and weeds. The last Platypus was recorded in this section around 1980 when a dead individual was found near Montmorency Park (Leigh Ahern pers. comm.). In the early 1970s, breeding populations were present just upstream of Greensborough. Important seasonal movements to the Yarra River of upstream populations in the Plenty Gorge may now be prevented. Freshwater Blackfish were still being caught at Partingtons Flat in the early 1970s. Blackfish were formerly very common in the stream. The river has become polluted and much of the native riparian vegetation has been replaced by weeds. Alien fish, including very large schools of Roach, dominate in the river.

Electrofishing site—Montmorency Park. The water had a high turbidity/siltation rate and was polluted from urban stormwater drains. There was a very poor cover of instream and native riparian vegetation. Montmorency Park lies on the floodplain to the east of the river. Housing at Yallambie occurs close above the steep west escarpment of the river. Severe bank erosion slumping and gullyng and tree and bank undercutting has occurred. This had caused several old Manna Gums to fall into the Plenty River. Trampling from residents, particularly on the steep west escarpment, is causing bank erosion and weeds are replacing indigenous vegetation.

Improve the water quality of the Plenty River. The improvement of river water quality is an important issue with regard to public health standards and the survival of instream species. The populations of instream species such as the Freshwater Blackfish and Platypus have been eliminated from the lower reaches of the Plenty River and are critically depleted within the middle reaches of the system in the Plenty Gorge. On continuing trends, both species are unlikely to survive in the Plenty Gorge far into the twenty-first century unless stream conditions improve markedly upstream and downstream.

PLH C DIAMOND CREEK

This management unit consists of one site of state faunal significance (site 46) and two of regional significance (sites 47 and 48) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 372270 to 7922 385294 (Diamond Creek); 7922 361264 (south point); 7922 395286 (east point); 7922 367318 (north point); 7922 341309 (west point).

Location/Size: The Diamond Creek and adjacent catchments bounded by Allendale Road, Reynolds Road, Black Gully/Ironbark Roads and Yan Yean Road. Approximately 1000 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands and along with the downstream unit (Eltham), forms the lower reaches of the Diamond Creek. The creek contains a broad floodplain above and below Diamond Creek township. The floodplain becomes constricted in sections between parallel lines of north-south hills and spreads out at the confluence of streams (e.g. the Challenger Street floodplain between the Sawpit Gully and Dry Creeks). Extensive colluvial outwash deposits have developed in the broad valleys and hill-slopes that occur along the eastern tributaries. Downfolding of the earths crust associated with the Greensborough syncline has left the higher sandstone strata exposed and buried the siltstone strata. The Silurian siltstone/mudstone in the east is associated with the upfolded Templestowe anticline. These are areas of bedrock which are highly resistant to erosion.

Landforms

Foothill: ridges, hill-crests, hill-slopes, gullies, valleys, stream, creeks and dams. Alluvial/volcanic plain (both minor occurrences): volcanic cappings, sand-plains, plain-slopes and stream floodplain, freshwater meadows and lagoons. The Diamond Creek floodplain contains small ephemeral freshwater meadows and ponds. There are five large gold mines (Union Mine, Nillumbik Tunnel, Diamond Creek Mine, Golden Stairs Mine and Pioneer Mine). Elevation is 50–200 m (Yarrambat).

Hydrology

The Diamond Creek is perennial and contains slow-moving and deep open water pools and faster-moving rocky/sandy riffles. The creek pools in sections below Challenger Street are over 1.5 m deep and contain submerged logs, emergent snags and mudbars (silted over sandbars). There are sections of rapids containing rocky riffles. The high banks of the creek as it meanders around the base of Mine Hill contains low rocky cliffs and steep hill-slopes; the low banks on the west side lie adjacent to alluvial floodplains. The floodplain also contains a remnant swamp at Challenger Street which was formerly part of an extensive lagoonal/paperbark swamp system of over 100 ha which stretched north of Diamond Creek township.

Sawpit Gully Creek and Dry Creek are ephemeral tributaries of the Diamond Creek, running about six to eight months of the year, but drying and generally lacking natural pools over late summer/early autumn. Prior to damming and land clearing in the catchments the tributaries probably ran for nine to 10 months and dried to strings of shallow pools for short periods. In wet years they probably maintained a small flow over summer/autumn, fed from seepage and springs. Originally, the creeks contained shallow pools, exposed rocky reefs and cobble and gravel riffles with sandy banks. The creek channels are now deeply scoured and the banks are undercut and have undergone severe slumping and erosion. The water quality is poor, apparently contaminated by septic tank and domestic water outfall.

Rainfall: 650–680 mm.

Site 46 Diamond Creek

- Map Reference:** 7922 373270 to 7922 368278 (Diamond Creek); 7922 367277 (Challenger Street Swamp); 7922 375276 (Dry Creek above the confluence with Diamond Creek); and 7922 373289 (Gipson Street Lagoons). One minute lat/long grids include 37° 40' x 145° 08' to 10', 37° 41' x 145° 09' to 10'.
- Location/Size:** Approximately 290 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: town reserve (Shire of Nillumbik); streamway reserve (Melbourne Parks & Waterways); rail reserve (V Line); public open space—Dry Creek block between Phipps Crescent and Allendale Road (Shire of Nillumbik). Private: remainder of site, mostly north of Phipps Crescent. The private land consists of bushblocks, farmlets and some cattle and horse agistment properties. Residential areas to the north (Diamond Creek), south (North Eltham/Research) and west (St Helena).
- Landforms:** Foothill and alluvial plain (see PLH C). Elevation is 50–140 m.

Natural Heritage Values

Landscape. The overlap of the alluvial plains and lowland hills biophysical types is poorly represented in the biological reserve system of Victoria. The Blakely's Red Gum grassy woodland of the Diamond Creek floodplain and plain-slopes east of Diamond Creek township provide the most extensive and intact occurrences of a vegetation type occurring only as remnants elsewhere in GM. This area forms the proposed Blakely's Red Gum Critical Conservation Area in NEM. It also contains the only extensive area of public open space in the Diamond Valley outside the Plenty Gorge. The riparian/instream habitat in the Challenger Street area is the most natural occurring in the Plenty Lowland Hills section of the Diamond Creek (most other sections are highly degraded and fragmented). The site supports historical and archaeological values worthy of protection and biological values worthy of rehabilitation.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference stands: nil

Relatively intact and extensive stands: Manna Gum (floodplain terrace) riparian forest (5.2); Manna Gum (creek) riparian forest (5.3); Blakely's Red Gum grassy woodland (14.5); Common Tussock-grass–Tall Sedge seasonal wetland (25.5)

Rare species: Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Blakely's Red Gum Critical Conservation Area. Strategic Habitat Link.

Notable features: Challenger Street Swamp/wetland complex. Union Mine/Nillumbik Tunnel

FAUNAL SIGNIFICANCE: Site 46 Diamond Creek

Assessment: State—Category 2 (B, C, D, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

46^a: 37° 40' x 145° 08'; Challenger Street Swamp (same grid as windy mile/**48^a**)

46^b: 37° 40' x 145° 09'; Diamond Creek township

46^c: 37° 40' x 145° 10'; Bishop Avenue/Phipps Crescent east of Diamond Creek township

46^d: 37° 41' x 145° 09'; Diamond Creek/Dry Creek, Union Mine to Allendale Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 46^b: Regent Honeyeater: Fyffe Street, February 1980

b. Vulnerable fauna

State. 46^d: Swift Parrot: two sightings of 12 and 10 birds (see **Fb**)

c. Rare fauna

Regional. 46^d: 3 species: Lewin's Rail, Common Bent-wing Bat and Eastern Broad-nosed Bat

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 46^b: 15 species and 51 birds on the Gipson Street Lagoons on 10 April 1991

f. Breeding migratory insectivores

Regional. 46^d: 9 species including the Rainbow Bee-eater and Sacred Kingfisher between the railway bridges on 27 October 1990

g. Breeding parrots

Regional. 46^d: 6 species including the Rainbow Lorikeet and Red-rumped Parrot in the Manna Gums on 27 October 1990

h. Bats

State. 46^d: 8 species including the Eastern Broad-nosed Bat and Eastern Freetail Bat trapped near the railway bridges from 11-13 March 1992

i. Arboreal mammals

Regional. 46^d: 4 species including the Sugar Glider and Feathertail Glider in Manna Gum/Silver Wattle at the railway bridges on 11 March 1992

k. Frogs

State. 46^d: 11 species in March 1992 between Challenger Street Swamp and the Diamond Creek

l. Reptiles

Regional. 46^d: 8 species including Marbled Gecko, Red-bellied Black Snake, Southern Water Skink and Delicate Skink at rail bridges in March 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 46^d: over 150 species

b. Native birds

Regional. 46^d: over 110 species

c. Native mammals

Regional. 46^d: 19 species (9 bat species)

d. Herpetofauna

Regional. 46^d: 21 species (11 frog species)

f. Butterflies

Regional. 46^d: 23 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 46^d: 19 species

b. Regionally endangered fauna (R1 species)

Regional. 46^d: 2 species. **Birds:** Little Friarbird. **Mammals:** Eastern Broad-nosed Bat.

c. Regionally vulnerable fauna (R2 species)

Regional. 46^d: 5 species. **Birds:** Lewin's Rail, Fuscous Honeyeater. **Mammals:** Eastern Freetail Bat, Common Bent-wing Bat. **Frogs:** Peron's Tree Frog

Regional. 46^b: 1 species. **Birds:** Little Egret

d. Regionally rare fauna (R3 species)

Regional. 46^d: 5 species. **Birds:** Pink Robin, White-browed Woodswallow. **Mammals:** Feathertail Glider. **Reptiles:** Broad-shelled Tortoise, Marbled Gecko

e. Regionally depleted fauna (R4 species)

Regional. 46^d: 7 species. **Birds:** Swift Parrot, Australian King-Parrot, Rainbow Bee-eater. **Mammals:** Platypus. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet. **Butterflies:** Blue Jewel

Regional. 46^a: 2 species. **Birds:** Buff-banded Rail, Latham's Snipe

Local. 46^b: 1 species. **Birds:** Latham's Snipe

f. Regionally restricted fauna (R5 species)

Regional. 46^d: 17 species. **Birds:** Cattle Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Phigalia Skipper, Meadow Argus, Dark Purple Azure

Local. 46^b: 6 species. **Birds:** Royal Spoonbill, Great Egret, Cattle Egret, Little Eagle, Rainbow Lorikeet. **Reptiles:** Common Long-necked Tortoise

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 46^a: 25 Latham's Snipe at Challenger Street Swamp on 23 October 1994

b. Rare or threatened fauna

State. 46^d: Swift Parrot: 12 in flowering Manna Gums at the rail bridges on 10 March 1990; 10 amongst large Yellow Box between Dry Creek and Allendale Road on 16 April 1993

g. Rare/restricted colonial fauna

Regional. 46^d: 10 Common Bent-wing Bats leaving the lower entrance of Nillumbik Tunnel on 13 March 1992

k. Regionally endangered fauna (R1 species)

Regional. 46^d: 7 Little Friarbirds in flowering Manna Gums near the railway bridges on 13 March 1992

m. Regionally rare fauna (R3 species)

Regional. 46^d: 6 White-browed Woodswallows (probably bred locally in the Manna Gums) at the railway bridges from 11-13 March 1992

Outlook

The biological significance is declining with increased subdivision and severance of habitat links in the east of the site. Instream values of the Diamond Creek are also declining. Recreation pressure along the floodplain is conflicting with ground fauna and wetland values. Maintenance of State zoological/High habitat significance values will require the implementation of sound land-use and conservation management practices.

FAUNA

Rare or Threatened Fauna

Ba **46^b: Regent Honeyeater.** A single bird was recorded in urban/Blakely's Red Gum grassy woodland (14.5) at Fyffe Street between 10-12 February 1980 (Peter Menkhorst pers. comm.). This was prior to the survey period. The species was frequently seen along the Diamond and Arthurs Creeks in the 1970s but since the late 1980s few sightings have been made. The species possibly still visits the Diamond Creek area in late summer of years that Manna Gum flowers heavily (five to six year cycles). At such times this section of the Diamond Creek provides a habitat link from Eltham South and Warrandyte on the Yarra River to areas upstream at Cottles Bridge and Nutfield (Arthurs Creek). There is an extensive stand of young Manna Gums on the floodplain between the lower and upper railway bridges. The existing old trees are quite healthy. Development of more extensive bands of Manna Gums along the floodplain in combination with Silver and Black Wattle, would benefit the Regent Honeyeater.

Consolidation of known feeding grounds and the links between these areas (e.g. Cottles Bridge on the Diamond Creek to the Yarra River) are crucial components of a recovery program for the honeyeater. Survival of this species in NEM is dependent on enhancement of Manna Gum links along streams and the arrest of fragmentation and declining vigour of stands of Red Ironbark.

Bb **46^d: Swift Parrot.** Twelve birds were seen in flowering Manna Gums (riparian forest; 5.2/5.3) along the banks and floodplain terrace of the Diamond Creek near the middle railway bridge on 10 March 1990. A flock of 10 birds was also seen amongst large Blakely's Red Gums and Yellow Box (grassy woodland; 14.5) in the paddocks east of the end of Godber Road between Dry Creek and Allendale Road on 16 April 1993. These birds were feeding on leaf psyllids. The large trees in both sections appear important early season feeding areas for the species. Revegetation of grassy woodland in the open space of the Dry Creek would benefit highly mobile species such as the Swift Parrot. Extensive areas of habitat (e.g. Plenty-Janeville Mine area) are required to support large feeding aggregations.

When in such numbers, the Swift Parrot is a eucalyptus dieback control agent. Dieback is an acute problem in the lower reaches of the Dry Creek due to woodland fragmentation which has favoured Bell Miners and Noisy Miners. Most of the tree species present (River Red Gum, Blakely's Red Gum, Yellow Box, Swamp Gum, Red Stringybark, Swamp Gum and Narrow-leaf Peppermint) are susceptible to foliage insect induced dieback.

Bc **46^d: Common Bent-wing Bat.** A large colony (several hundred) of Common Bent-wing Bats inhabited the Nillumbik Tunnel about 20 years ago (Craig Smith pers. comm.). Around this time most of the vertical shafts were back-filled and the level of disturbance from human visitation in the tunnel increased. About ten Common Bent-wing Bats were observed leaving one of the open lower level adits on 13 March 1992. No bats were recorded leaving the adit or an open cut area directly above (leading to a ventilation shaft) on a subsequent watch on 5 May 1992. Possible conclusions are that the mine now only serves as a summer roost for a small population of males (see One Tree Hill site), or the back-filling and increased levels of human visitation to mines in the inner section of NEM has caused a decline in local populations.

Bc **46^d: Lewin's Rail.** One was seen foraging on mudflats along a secluded, heavily vegetated section of the Diamond Creek upstream of the Dry Creek confluence on 13 March 1993 (Manna Gum (creek) riparian forest (5.3)). Most sightings of the rail have been of single birds along creeks in NEM. A Nankeen Night Heron was observed in the same area.

Bc **46^d: Eastern Broad-nosed Bat.** One was triplined at the yabby dam west of the middle railway bridges on 13 March 1992. Most of the records in GM have been from near streams in the lowland plains and hills of NEM.

Critical Assemblages or Populations

- Ch* **46^d: High diversity of bats.** A State significance assemblage of eight species including the Eastern Broad-nosed Bat and Eastern Freetail Bat was trapped between the lower and upper railway bridges between 11 and 13 March 1992. The White-striped Freetail Bat was heard while spotlighting the trapsite on 11 March 1992. The vegetation was Manna Gum riparian forest (5.2/5.3). Each of these nine species would also likely occur in the Blakely's Red Gum grassy woodland (14.5) in the eastern section of the site (e.g. Phipps Crescent) but this area was not trapped during the survey. A tenth species, the Common Bent-wing Bat, was observed leaving an entrance to Nillumbik Tunnel on 13 March 1992. The broad-nosed bat and freetail bat were triplined at the yabby dam west of the middle railway bridges on 13 March 1992. The others (apart from the bent-wing bat) were captured with a harp trap.
- Ck* **46^d: High diversity of frogs.** Eleven species were recorded between 11 and 13 March 1992 along the Diamond Creek floodplain downstream of Challenger Street. This was the highest single survey diversity recorded in GM. There were representative species of lowland river billabongs (Peron's Tree Frog) and grass plains (Common Spadefoot Toad and Bibron's Toadlet) and mountain forests (Victorian Smooth Froglet). The Peron's Tree Frog and Striped Marsh Frog were recorded at the yabby ponds while the Growling Grass Frog occurred at pools in the creek and in the larger floodplain dams. The Common Spadefoot Toad is characteristic of low rainfall volcanic plains grasslands and grassy wetlands. It reaches its eastern range limit in GM on the floodplains of the Diamond Creek. Vegetation includes Manna Gum (floodplain terrace) riparian forest (5.2), Manna Gum (creek) riparian forest (5.3) and Common Reed-Cumbungi seasonal wetland (25.7) around the larger floodplain dams.

Other Significant Fauna

Birds

- Eb* **46^d: Little Friarbird.** Seven birds were seen in the flowering Manna Gums (5.2/5.3) between the downstream and middle railway bridges on 13 March 1992. They are nomadic and irregular late summer visitors following flowering eucalypts, particularly along streams.
- Ee* **46^a: Latham's Snipe and Buff-banded Rail.** The Common Tussock-grass-Tall Sedge floodplain herbfield (25.5) of Challenger Street Swamp is the last relatively intact representative of its type remaining in the Diamond Creek system. It was formerly widespread from Eltham to St Andrews and Hurstbridge to Strathewen along Arthurs Creek. Latham's Snipe visit the swamp every spring. Twenty five were present on 23 October 1994. The wetland is the most important snipe swamp in the Diamond Creek catchment and one of the most important in NEM. With improved management including removal of horses and disturbance from humans, the wetland could support over 50 birds. This would be of State significance. The international snipe agreement recommends that wetlands of this standing be protected. In wet years the Buff-banded Rail is also present (one on 9 October 1991).
- Ee* **46^d: Rainbow Bee-eater.** Several adults and juveniles were recorded around the junction of the Diamond Creek and Dry Creek on 11 March 1992. Breeding burrows were present in the banks of Dry Creek. Several colonies bred along the Diamond Creek near the middle railway bridge in the 1970s. Rainbow Bee-eaters have become rare along the Diamond Creek system over the last decade. Declining water quality (e.g. insecticide and pollution), riparian habitat loss and weed invasion (each limiting insect prey) and slumping of bare creek banks (limiting nesting habitat) due to rabbit and livestock activity are probable contributing factors. Black Rats may be predated eggs and nestlings from nests.
- 46^b: Seasonal waterbird counts on the Gipson Street Lagoons.** The lagoons provide one of the best areas for common waterbirds in the Diamond Creek system. They are artificial ponds formed out of what was once an extensive area of swampland that stretched to south of Chute Street. A total of 22 species of waterbirds were recorded from four mid-season 20 minute counts in 1991 (January, April, July and October). The peak count was on 10 April 1991 when 51 individuals of 15 species were recorded. An average of 12 species and 44 individuals were recorded over the four counts. Half the individual counts were Purple Swamphens and Pacific Black Ducks. Single Royal Spoonbill, White-necked Heron and Little Egret and ten Cattle Egrets were seen in

April, two Straw-necked Ibis and a pair of Chestnut Teal were seen in July and a single Latham's Snipe was seen in October. More extensive searching of the reed-beds would likely reveal additional cover-dependent species, including occasional crakes (e.g. Spotted Crake) and rails (e.g. Buff-banded Rail).

46^d: Manna Gums—important waterbird roosts. Up to 100 waterfowl (mostly Australian Wood Ducks and Pacific Black Ducks) roost at the Challenger Street lagoons and dams. Other roosting species include the Little Pied Cormorant, Little Black Cormorant, Nankeen Night Heron, White-faced Heron, Cattle Egret (autumn to early spring) and Australian White Ibis (autumn to early spring).

46^d: Manna Gums—important parrot habitat and faunal corridor. The Manna Gum riparian forest (5.2/5.3) forms important feeding and nesting habitat for parrots. Six nesting species (and potentially others) were recorded near the railway bridges on 27 October 1990. The Diamond Creek floodplain is the most important foothill stream for lorikeets. The Little and Purple-crowned Lorikeet (scarce in the eastern section of NEM) were both recorded in flowering Manna Gums near the railway bridges in March 1992. The township Blakely's Red Gums and gardens support large populations of the Rainbow Lorikeet and Musk Lorikeet. The Australian King-Parrot disperses into the site from breeding grounds in the ranges during autumn (seen near the railway bridges in March 1992). They formerly bred locally but their breeding range has contracted to the ranges due to shooting, clearing of nest-trees and habitat fragmentation.

Mammals

Ee **46^d: Platypus.** The Platypus was observed in the Diamond Creek upstream of the Dry Creek confluence on 13 March 1993 (Manna Gum (creek) riparian forest (5.3). The creek was apparently more polluted in the 1970s before township sections of Diamond Creek, Wattle Glen and Hurstbridge were sewered. Interviews with residents suggest that the Platypus had disappeared from the stream by the early 1970s. The species does not appear to be resident as no active breeding burrows were located. Non-breeding animals from the Yarra River visit in autumn-winter. This may be due to the improved water quality of the creek. For Platypus to breed, rests with further improvement in water quality by streamway conservation and revegetation as well as public education (to reduce the level of harassment from humans and dogs).

46^d: Poor ground mammal fauna. This appears so often the case in near-urban areas. The native ground marsupial fauna is impoverished with only the two largest species (Common Wombat and Eastern Grey Kangaroo) being recorded. This may be due in combination to loss of habitat links and ground cover (e.g. logs), nocturnal incursions by dogs and the presence of large populations of foxes and (probably) cats. Black Rats are common, no doubt encouraged by the mining activity, the proximity of the town, rubbish and Blackberry. Rabbits are common on the skeletal hill-slope escarpments of the creek and have caused considerable erosion.

46^d: Relatively diverse arboreal mammal fauna. The arboreal marsupial fauna includes both the Feathertail Glider and Sugar Glider. The site contains a high proportion of mature trees (particularly Manna Gums, Red Box and Yellow Box) with large tree-hollows. A very large population of Common Brushtail Possums is present. Six juvenile animals were seen emerging in March 1992 from an old Manna Gum by the creek, possibly a communal non-breeding roost.

Reptiles

46^d: Poor reptile fauna. The fauna is depleted with only three skink and two snake species being recorded. The likely reasons are as discussed for the ground mammals above. One of the snakes (Red-bellied Black Snake) only persists in densely vegetated sections of the creek. It has possibly been eliminated from the township sections of the creek. The Marbled Gecko was spotted while it foraged amongst strips of hanging bark near the base of a Manna Gum. This species is rare in the foothills.

Frogs

Ec **46^d: Peron's Tree Frog.** They were present (a few calling) at the yabby ponds in March 1993. This species is associated with Swamp Paperbark/River Red Gum billabongs and swamps of the Yarra and Plenty River. Its presence in this site provides background to the original vegetation of the Diamond Creek floodplain. River Red Gum (plains) drainage line woodland (30.1) occurred along the upper floodplain drainage lines and Swamp

Paperbark swamp scrub (17.1) fringed the lagoons. Remnants of the former can be seen in Nillumbik Park and along Bishop Avenue while the Swamp Paperbark has been totally cleared.

Butterflies

46^d: Mine Hill/Dry Creek valley. The spur on the south side of Mine Hill is an important hill-topping and mating area for butterflies. The Diamond Creek floodplain is also a productive area. Twenty three species including the Phigalia Skipper, Bright Shield Skipper, Dispar Skipper, Symmomus Skipper, Meadow Argus, Dark Purple Azure, Olane Azure, Blue Jewel and Common Dusky Blue were recorded from four visits in 1992.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. Partially fragmented riparian habitat links upstream to the Wattle Glen to Hurstbridge site and downstream to the Eltham North site and an overland link east to the Pretty Hill site. Ineffective overland links west to the St Helena and Plenty River–Diamond Creek Link sites. The Diamond Creek site is the most important connection in the urban area between upper Diamond Creek/Kinglake National Park and the Yarra River. It forms the strategic habitat link in the lower reaches of Diamond Creek. Revegetating open space surrounding Dry Creek between Allendale Road and Phipps Crescent would significantly improve the role of the site as an overland habitat link between Diamond Creek and Watsons Creek.

Green web park.

<p>Habitat link fragmentation. The site contains partially fragmented riparian and overland habitat links (see conservation measures). Dry Creek drains partially cleared farmland between Phipps Crescent and Allendale Road. Its headwaters are near Kangaroo Ground at Pretty Hill and above Eltham College in the Research management unit. Further fragmentation and habitat loss will be detrimental to the fauna of the urban areas of the Shire of Nillumbik. This imbalance is a symptom of urban or intensively farmed areas and usually foreshadows declining habitat and faunal values.</p>	<p>Strengthen habitat links. The site remains critical in the regional network of habitat links and is designated a Strategic Habitat Link in NEM. The designation has two purposes: to highlight the importance of the site as a link to downstream sites; to highlight the need for urgent enhancement of links within the site. Re-establishment of these links (especially a north-south riparian link along the Diamond Creek and an east-west overland link along the Dry Creek) would be critical to maintaining faunal values in the site. Links need to be broad and diverse. The open space catchment of the Dry Creek link offers scope for this (see following paragraphs). Landowners surrounding this link should be encouraged to undertake conservation management of their land in accordance with the Regional Habitat Link Strategy (see margin note for detailed management suggestions)</p>
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Hill-crest and hill-slope degradation—grazing and soil erosion. The hill-slopes above Dry Creek are severely degraded and are heavily grazed by cattle and horses. Despite a scatter of large trees, little regeneration has occurred. Red Stringybark herb-rich foothill forest (6.1) on the south-east facing slopes of Dry Creek has been heavily cleared. A few huge Narrow-leaf Peppermints remain. Manna Gum gully woodland (10.1) along Dry Creek is degraded. The hill-crests and dry west-facing slopes have become severely degraded by excessive land clearing and livestock grazing. Degraded stands of Yellow Gum–Red Box box–stringybark woodland (12.3) occur near the water tank on Phipps Crescent.

The steep skeletal hill-slopes of Mine Hill supporting Red Box–Red Stringybark box–stringybark woodland (11.1) have been eroded and are infested with rabbits, foxes and weeds (e.g. Boneseed and Cape Weed). Without substantial land protection and revegetation works they remain non-viable native habitat. Blakely's Red Gum grassy woodland (14.5) and Yellow Box–Candlebark valley forest (31.1), which occurred on the opposite (north-facing) side of Dry Creek, has also been cleared. Intensive horse and cattle grazing on this side in recent years has prevented tree and shrubland regeneration (a few eucalypt saplings have struggled through the undergrowth of Blackberries).

The annual autumn–winter use of the Dry Creek area by Wedge-tailed Eagles demonstrates its importance as a habitat link and open space. The birds appear to be the pair from North Warrandyte (Stony Creek). Occasionally the Watsons Creek birds also enter the area (both pairs were seen on 16 April 1993). These are the last birds to regularly visit the near-urban section of the Shire of Nillumbik. The feeding grounds of the Dry Creek catchment may be critical for the North Warrandyte birds. Fragmentation of the link and higher density land settlement in the Dry Creek catchment may prevent them from visiting the lower Diamond Creek and would likely threaten their survival.

Proposal for the establishment of a 'green web' park. Substantial parks occur along the Plenty River and Yarra River. The Diamond Creek supports none of any extent and quality. Of the expanding residential sectors in the lowland hills of NEM, the Diamond Creek catchment contains by far the least land in biological reserve. There is enough public land and open space in the site (approximately 150 ha) to provide the core area for a biological reserve. There is also ample scope for the development of passive public recreation areas. The proposed park would form a wedge between residential development to the south and west and the conservation zone to the north and east (see planning recommendations). It would be a park of significant and strategic biological and archaeological significance. The diversity offered by the proposed park has high potential for public interpretation of natural heritage values. It is viewed the only opportunity to secure an extensive biological reserve/regional park in the lower Diamond Creek system.

Together with the contiguous lower reaches of the Diamond Creek connecting the Yarra River, the open space should be developed as an integral part of the 'green web' system of the Open Space 2000 program. The establishment of this as a 'green web' park is a primary objective of the Regional Habitat Link and Hydrological Strategies for the Shire of Nillumbik. This would consolidate one of only two remaining functional links (the other being One Tree Hill/Watsons Creek) between the Yarra River and the Kinglake Ranges. Other coastal/ranges links closer to Melbourne have been lost to urban development (e.g. Plenty River Yallambie to Greensborough unit). Management should protect and rehabilitate existing stands of native vegetation and develop effective habitat links between these areas.

Bell and Noisy Miners—psyllid infestations and tree dieback. Bell Miner populations are highest along sections of the creek where the forest and woodlands have been fragmented. Tree clearing, the territorial activity of the Bell Miners and the elimination of shrubs by livestock grazing have each contributed to the loss of beneficial insectivorous birds and subsequent heavy infestation of trees by psyllid insects (notably *Glycopsis* sp. on the Blakely's Red Gums). Swamp Gums, Manna Gums and Narrow-leaf Peppermints are also being damaged by insect defoliation and tree dieback. Remnant stands of Blakely's Red Gum in residential areas support substantial populations of Noisy Miners. Trees are undergoing acute dieback, a scenario that will occur in the large stands between Phipps Crescent and Perversi Avenue, as urban development proceeds.

Restriction of further subdivision or urban development. The reserves along the Diamond Creek floodplain and open space, bushblocks and farmlets occurring to the east provide a Strategic Habitat Link and contain significant flora and fauna values. This area should be consolidated under a planning zone overlay which limits subdivision potential.

The most significant private land areas are the stands of Blakely's Red Gum between Perversi Avenue and Phipps Crescent, bushblocks along the south end of Dering Street and adjoining timbered farmland. The most significant public land areas are the floodplain, streamway and escarpment vegetation and stands of Yellow Box and Blakely's Red Gum on the south side of Dry Creek. Subdivision of land containing significant bushland (e.g. orchid flora) should require an Environmental Impact Assessment. .

Regional Hydrological Strategy

Creek bank degradation by livestock and earthworks; weeds and slumping. Stock gain access to all but the confluence section of Dry Creek. Erosion and slumping of the creek banks has occurred and rubbish has been dumped in several sections of the creek. Slopes and gullies immediately above the creek have undergone sheet and tunnel erosion caused by rabbits and overgrazing by livestock. The banks upstream of the Diamond Creek confluence contain solid Blackberry. This harbours foxes, rabbits and Common Blackbirds.

Wetland management plan for the Challenger Street floodplain. A management plan for restoring the significant wetland area at Challenger Street Swamp and yabby dams and adjacent section of Diamond Creek is strongly recommended. The snipe habitat at Challenger Street Swamp needs protection and management including weed removal and revegetation works (particularly shrub/tree strata). A perimeter predator fence should be constructed. A diverse system of wetlands is present on the floodplain. These are largely unprotected and under-utilised by waterbirds. Higher ground should be planted with Yellow Box and Blakely's Red Gum and clumps of Golden Wattle, Hedge Wattle and Blackwood. Once these establish herb species such as Kangaroo Grass and Spiny-headed Mat-rush could be replanted.

Grazing of Challenger Street Swamp. The Challenger Street Swamp is grazed by horses. This has caused ground compaction when the soil is wet, weed invasion and loss of floodplain herbfield vegetation and bird and frog habitat.

Disturbance of waterbirds at the Gipson Street Lagoons. Non-passive recreation and unrestrained dogs in the vicinity of the Gipson Street Lagoons disturb waterbirds.

Reduce horse grazing on the Challenger Street floodplain. Horse grazing should be reduced overall and excluded from revegetation areas of the Challenger Street floodplain, particularly the Challenger Street Swamp. This would enable regeneration of the threatened herbfield vegetation.

Sections of the creek flats including the three yabby dams to the south-east of Challenger Street should be incorporated into a **wetland reserve**. There is scope for wetland development between the Challenger Street Swamp and the creek. Additional ungrazed or unmown grassy verges to the wetlands would provide snipe, rail and quail habitat. The public should be restricted from revegetation areas. Sections of the floodplain horse paddocks south of Challenger Street should be fenced and replanted with Manna Gum, Silver Wattle and Tree Violet (the latter to provide cover and nest-sites and the former two to provide food for insectivorous birds).

The swampland should be planted with clumps of Swamp Gum, River Red Gum and Swamp Paperbark. The edges of the northern yabby dam and the dam environs in the horse paddock should also be fenced and replanted with these species. With restricted access to horses the drainage line belts of emergent herbfield (e.g. Common Reed, Cumbungi, Swamp Crassula and Common Spike-sedge), which are important for waterbirds and frogs, would expand. Ideally more wetland area and diversity should be developed at the yabby dams. A large tree-but has been placed in the northern end of the large dam. More logs and planted trees (potential roosts) are required.

Wetland visitor use plan on Gipson Street floodplain. Bird viewing areas and interpretation facilities through the erection of hides at Gipson Street would raise the public awareness of the diversity of waterbirds in the area. Non-passive recreation should be conducted away from the wetland areas as many of the rarer waterbirds are shy of disturbance. Dogs should be restrained.

V Line management of creek frontage/rail maintenance operations. The creek and adjacent flats near the railway bridges contain extensive areas of Blackberry and some Boneseed and Montpellier Broom. Disturbed banks are dominated by alien grasses (notably Cocksfoot, Yorkshire Fog-grass, Panic Veldt Grass and Annual Veldt Grass). English Ivy has ringbarked several large Manna Gums on the stream bank and trees on the convex side of bends have been undermined by bank slumping. Earthworks conducted by V Line above the creek bank has removed native vegetation, causing bank slumping, creek turbidity and the spread of weeds.

Flood mitigation, reclamation of lagoons and creek straightening. The ovals on both sides of Chute Street between the creek bridge and the hotel are built on fill over a large lagoon (Ryan 1972). The course of the creek was re-aligned around the western side of the ovals. The section downstream of the bridge was straightened and desnagged for flood mitigation.

Establishment of interpretation facilities and nature trail for the Challenger Street floodplain.

The birdlife is diverse and the creek area has high potential for public interpretation of wetland nature conservation. With nature walks and hides, viewing areas for birds (particularly waterbirds) and the Platypus could be made available. Apart from the Gipson Street Lagoons, little else is presently available between Eltham and Wattle Glen and nothing approaches the quality of the riparian bushland between the lower and middle railway bridges.

Access and nature trail systems should remain restricted to the floodplain west of the railway. Guided walks could be conducted in sections east of the railway. This area is relatively secluded and is important for the Platypus. There is a bike path present along the western side of the creek between Allendale Road and Chute Street. At times it passes close to the creek bank and has scope for the establishment of a nature trail. Foot traffic and mowing have led to erosion of the bank in these sections. At best, a single strip of Manna Gums and some Silver Wattles and Hawthorns and few native species in the field layer, apart from some Common Tussock-grass and Weeping Grass, is present. A revegetation strip 10 m wide would provide habitat for scrub fauna and a better screen for waterbirds from the passers-by.

Decline of native fish. The section of Diamond Creek upstream of Dry Creek (where the Platypus, Lewin's Rail and Nankeen Night Heron were seen) supports the most natural riparian/instream habitat in the lower Diamond Creek. Freshwater Blackfish were caught near the Dry Creek confluence in the early 1970s. It was intended to electrofish this section of the creek in April 1992. This could not be achieved as the water was turbid and high. The creek had become swollen from light overnight rain. The rise in water was not evident in the Diamond or Arthurs Creeks above Hurstbridge. This indicates that after flash flooding, mildly polluted urban runoff provides a significant portion of the summer-autumn water flow in sections of the stream below Diamond Creek township. The introduced Roach and Goldfish were the only fish seen while spotlighting. It is possible that small populations of Freshwater Blackfish and Southern Pigmy Perch persist. A freshwater fish survey is required. Integrated conservation management over the total catchment of the stream will be necessary if native fish species are to persist, little own recover, in this section of the stream (see Regional Hydrological Strategy).

Earthworks from housing developments leading to creek siltation. Heavy silt loads are dumped into the creek from earthworks in new housing estates.

Require freshwater fish survey. The native vegetation and riparian and instream habitat (e.g. logs and mudbars) of the Challenger Street section of the Diamond Creek is of higher quality than immediately upstream and downstream. Under active conservation management the biological values could be raised. The area should be surveyed for freshwater fish.

Other Issues

Disturbance from old mining activities; human access into the Nillumbik Tunnel. Extensive damage to the native vegetation on the western slopes of Mine Hill and the adjacent section of the Diamond Creek was caused during the operation of the Nillumbik Tunnel. The tunnel connects internally to water-filled vertical shafts. Collapses in the horizontal drives have occurred. From the presence of droppings, Common Bent-wing Bats have inhabited the accessible lower drives but due to human disturbance, have either vacated or been forced to roost in inaccessible sections in the interior of the mine.

No unauthorised internal access into the Nillumbik Tunnel—grills needed. An inspection on 5 May 1992 revealed that the mine had been visited and considerably disturbed during the preceding school holidays. This activity is increasing as residential areas have encroached closer to the mine. The event of a human fatality due to a cave-in or falling down a shaft is a high possibility (or even probability). As a matter of great urgency human access into the lower entrance tunnels must be closed-off with grills (that bats can move through). Security fencing is required around the open cut on private property further up Mine Hill. Every effort to avoid back-filling should be made given the historical significance of the mine and its usage by cave-bats.

Vermin populations—rabbits, rats, foxes and dogs. All species are common. Black Rats and foxes are abundant. Several roaming dogs (unknown whether domestic or feral) were recorded on the flats opposite the mine in March 1992. Two more were sighted near the mine in May 1992. Dogs would be limiting the local population of Common Wombats and have possibly eliminated the Black Wallaby from the site. Cats would also be a problem to wildlife.

Uncontrolled access—timber removal and fires. Cars and trail-bikes enter the site from Allendale Road. Ground timber has been removed for firewood. Fires are frequently lit causing weeds such as Boneseed and Montpellier Broom to proliferate.

Cave-bat recovery plan and monitoring study.

There are at least two external entrances which access the vast interior of the Nillumbik Tunnel/Union Mine complex. There is potential for Common Bent-wing Bats to inhabit the mine in greater numbers and subsequently recolonise areas which are now visited by humans. Rat control and extensive re-establishment of natural habitat and weed removal (particularly Blackberry, Boneseed and Montpellier Broom) in the adjacent areas would facilitate a more successful recolonisation. A bat monitoring study should be conducted. Information on the recolonisation ability of cave-bats is needed, given the recent loss of most known roost-sites nearer Melbourne. A research-based cave-bat recovery plan and public-awareness exercise at the Nillumbik Tunnel should be undertaken. A colony of cave-bats of the proportions that lived there 20 years ago would be of State significance.

Wandering and feral dogs. Several dogs were on the loose on each evening visit to the railway bridges area. With more effective dog controls, a safer haven for Black Wallabies and Common Wombats would be provided and they may be able to return in numbers to the Diamond Creek floodplain.

Development of a fire prevention strategy.

Severe bushfires in which many houses and some lives were lost occurred in the site in 1962 and 1969. A fire prevention strategy should be developed for the entire site which identifies the location of critical fire breaks and access points. This is necessary to protect nearby residential areas and bushblocks.

Implementation of Native Vegetation Clearance Controls on private land.

North side of Dry Creek revegetation plan. This area contains Red Stringybark herb-rich foothill forest (6.1) on sheltered hill-slopes and Red Box–Red Stringybark box–stringybark woodland (11.1) on hill-crests. Replanting of a link encompassing the lower hill-slopes and the creek valley (preferably a strip of at least 100 m width) is required. Funding assistance for fencing and follow-up weed control and replanting should be gained. Livestock would need to be retained on other (strategic) sections of the block for fire protection purposes. Farmland hill-crests containing Red Box on the southern spur of Mine Hill and hill-slopes containing Yellow Box and Red Stringybark in the lower catchment of Dry Creek (e.g. south of Fraser Street and James Cook Drive) contain scattered native trees and shrubs and a native-dominated field layer. The spur is an important archaeological site and hill-topping area for butterflies. Management of these areas should be compatible to that recommended for the adjacent ‘green web’ park. The field layer on the farmland hill-slopes is rich in native species. The slopes contain Kangaroo Grass and wallaby-grasses and the swales, gullies and seepage areas contain Hill Sedge and Weeping Grass. With reduced grazing pressure wildflower areas containing several locally rare orchids and other herbs would regenerate.

South side of Dry Creek revegetation plan. The area supports a diverse array of habitats, most of which are degraded. This includes Red Box–Red Stringybark box–stringybark woodland (11.1) on hill-crests and exposed hill-slopes, Blakely's Red Gum grassy woodland (14.5) on sheltered hill-slopes, Red Stringybark box–stringybark woodland (11.3) in exposed valleys, Yellow Box–Candlebark valley forest (31.1) in sheltered valleys and Manna Gum gully woodland (10.1) along the Dry Creek. A revegetated strip of at least 100 m width is also required on this side of the valley. The revegetation program may be important for the Swift Parrot, bats and the Rainbow Bee-eater and other insectivorous birds. A system should be devised to link roadside stands along Godber Road and Allendale Road that have become isolated by farmland. Open space and farmland containing native-dominated field layers and scattered trees (e.g. between Dry Creek and Godber Road) should be identified and fenced from livestock grazing. These should be replanted with shrub layer species.

Parkland restoration and community support-group formation. The relative intactness of the Diamond Creek presents excellent scope for a parkland restoration project (see the Darebin Parkland site). The extent of the Dry Creek area lends itself to a large-scale revegetation project. With the area and diversity offered by both, there is ideal scope for a high profile/achievement restoration and revegetation project. A community-based support group needs to form which deals with land protection and revegetation activities. The focus should be on fencing, weed eradication, protection of sensitive (e.g. fragile escarpments) and significant (e.g. secluded, well vegetated waterholes) sections of the creek and the re-establishment of a diverse wetland system. With adequate resources and management it offers some of the most diverse and intact floodplain habitat in the inner section of NEM.

Native vegetation clearance controls/conservation management. Conservation management by landowners of abutting private land should be encouraged through advice on the biological values of the land, management, the desirability of conservation covenants or other permanent protection, and on incentives for sustainable land management and habitat protection works. Acquisition of key areas of habitat on private land may be necessary to ensure that the habitat link is functional, however the voluntary co-operation of land owners should be sought in the first instance. Management input from informed and motivated landowners would greatly assist management of the adjoining public land areas.

Planning Recommendations

Critical Conservation Area—Blakely's Red Gum grassy woodland: Allendale Road to Perversi Avenue. The designation of the Blakely's Red Gum Critical Conservation Area is needed to consolidate all existing and potential stands of grassy woodland in the site under conservation management (in accordance with the Regional Habitat Link Strategy). The strategy contains specific guidelines for retaining and enhancing the most critically important stands (and their indigenous understorey vegetation) of threatened habitats in NEM. This relates to the streamway reserves and the public open space, bushblocks and farmlets occurring to the east of the railway line and between Perversi Avenue and Allendale Road.

Any proposed permit for subdivision in the Critical Conservation Area would require a full Environmental Impact Assessment. Rezoning sections between Allendale Road and Perversi Avenue to permit subdivision should be reconsidered on the basis that the area contains the most extensive and significant stand of Blakely's Red Gum grassy woodland in GM and other significant flora and fauna values. The bushland and low density settlement in the area provide the most effective overland habitat link in the lower Diamond Creek system. The Regional Habitat Link Strategy requires the protection of all Critical Conservation Areas in NEM and stronger conservation controls to appropriately manage their designated biological values.

Strategic Habitat Link. The Diamond Creek site is a strategic habitat link in North East Melbourne. These are sites in which habitat link utility is considered critical to the maintenance of faunal/habitat significance (in accordance with the Regional Habitat Link Strategy). The preservation and enhancement of these designated links is a key recommendation of the strategy. Strategic habitat links are the key site/series of sites within a particular biophysical zone or major catchment that are presently or potentially the most critical or important for local fauna movement.

Site 47 Plenty

- Map Reference:** 7922 365296 (Ironbark Road Reserve). One minute lat/long grids include 37° 39' x 145° 07' to 145° 08', 37° 40' x 145° 07'.
- Location/Size:** Stands of bushland and links occurring between Yan Yean Road and Ironbark Road. Approximately 320 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Reserve/Open Space (Ironbark Road Reserve, north of the southern loop of Murray Road). Private: zoned Landscape Interest C (generally 8 ha). Horse and cattle grazing farmlets and bushblocks.
- Landforms:** Foothills (see PLH C). Elevation is 80–180 m.

Scientific and Educational Values

Plant TYPE locality. Ironbark Road Reserve is the type locality of the Emerald Greenhood (*Pterostylis smaragdyna*).

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: nil

Relatively intact and extensive stands: Red Box–Red Stringybark box–stringybark woodland (11.1; Ironbark Road Reserve and between Heard Avenue and Seymour Drive)

Partially intact or small stands: Swamp Gum gully woodland (10.3; between Heard Avenue and Seymour Drive); Yellow Box–Candlebark valley forest (31.1)

Vulnerable species: Wine-lip Spider-orchid

Rare species: Emerald Greenhood

Critical assemblages or populations: Ironbark Road Reserve flora

Notable features: Golden Stairs Mine

FAUNAL SIGNIFICANCE: Site 47 Plenty

Assessment: Regional—Category 2 (B, C, D, E)

Reference grids for the significance keys include:

47^a: 37° 39' x 145° 07'; Golden Stairs Mine/Sawpit Gully Creek, Plenty

47^b: 37° 39' x 145° 08'; Ironbark Road Reserve environs, Diamond Creek

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 47^a: Common Bent-wing Bat (droppings in the Golden Stairs Mine of unknown date, possibly since the commencement of the survey period in 1986)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Regional. 47^a: 6 species including the Bibron's Toadlet and Victorian Smooth Froglet in a 20-minute frog count along the Sawpit Gully Creek on Hillmartin Lane on 4 May 1989 and along the Sawpit Gully Creek between Heard Avenue and Pioneer Road on 19 May 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 47^a: 90 species along the Sawpit Gully Creek

d. Herpetofauna

Regional. 47^a: 8 species in the valley of the Sawpit Gully Creek between Pioneer Road and Heard Avenue

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 47^a: 11 species

c. Regionally vulnerable fauna (R2 species)

Regional. 47^a: 2 species. Red-capped Robin. **Mammals:** Common Bent-wing Bat

d. Regionally rare fauna (R3 species)

Regional. 47^a: 4 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift, Pink Robin, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 47^a: 5 species. **Birds:** Whistling Kite, Peregrine Falcon, Bassian Thrush, White-winged Triller. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 47^a: 6 species. **Birds:** Painted Button-quail, Australian Pelican, Barn Owl, Rainbow Lorikeet, White-winged Chough. **Reptiles:** Bougainville's Skink

Outlook

Continued small bushblock and farmland subdivision and potentially residential subdivision would eliminate most of the regionally significant values of the site.

FAUNA

Please note: no fauna survey (apart from incidental records) was conducted in the Ironbark Road environs grid (47^b)

Rare or Threatened Fauna

Bc 47^a: Common Bent-wing Bat at the Golden Stairs Mine. Permission to enter the mine was obtained from the owner. Several old piles of bat droppings (probably Common Bent-wing Bats) were located in the interior of the upper level of the mine when visited on 21 May 1989. A gate erected by the owner to prevent the entry of children probably also excludes the bats (see conservation measures).

Other Significant Fauna

Birds

47^a: Bird list from the upper Sawpit Gully Creek. A list containing 87 native bird species was provided by Dr Ian Norman of ARIER. The area contains 8 ha bushblocks. Habitats consist of Red Stringybark herb-rich foothill forest (6.1) on the sheltered slopes, Swamp Gum gully woodland (10.3) along the creek, Red Box–Red Stringybark box–stringybark woodland (11.1) on the hill-crests and exposed hill-slopes and Yellow Box–Candlebark valley forest (31.1) in association with Burgan and Black Wattle in the valley.

Significant species on the list include the Collared Sparrowhawk, Painted Button-quail (breeding), White-winged Triller, Bassian Thrush, Red-capped Robin and Pink Robin. With the exception of the Plenty River bushland at Janefield, most of these do not occur closer to the urban area in the Shire of Nillumbik. Their long-term survival in the Shire is insecure. The thrush and both robins are rare winter visitors to the area. The Australian Pelican, Black Swan, Whistling Kite, Peregrine Falcon and Fork-tailed Swift were recorded flying over.

Frogs

47^a: Bibron’s Toadlet and Victorian Smooth Froglet. Each species persists along bushland sections of the Sawpit Gully Creek. The range of each has become severely restricted and fragmented by land settlement in the inner section of NEM. The Bibron's Toadlet was recorded in the middle reaches of the creek near Hillmartin Lane and in the upper reaches of the creek off Tiemen Road. The habitat at both areas was Yellow Box–Candlebark valley forest (31.1). It still occurs in the more intact stands of grassy woodland in the inner section of the Shire of Nillumbik, but is becoming rare and localised. The Victorian Smooth Froglet is restricted to damp gullies and creeks in the inner section of the Shire.

MANAGEMENT

Threatening Processes	Conservation Measures:
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Regional Habitat Link Strategy

Habitat connectivity. Habitat links becoming increasingly fragmented west to the Plenty–Janefield site, north-east to the Plenty River–Diamond Creek Link site and east to the Wattle Glen to Hurstbridge site. The site is important as it forms one of few remaining bushland links between the Diamond Creek and Plenty River.

<p>Bushland fragmentation. See neighbouring sites in PLH and NLH.</p>	<p>Strengthen habitat links. The site forms the most intact link between the Plenty Gorge and the Diamond Creek. Further fragmentation of the link may critically isolate the box–stringybark woodland and grassy woodland biota in the Plenty Gorge. An effective plan should be formulated for the retention of these links.</p>
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Other Issues

<p>The Golden Stairs Mine. Sections of the interior of the mine are dangerous and should not be accessed. In recent years a galvanised iron gate has been placed in front of the entrance to prevent access by local children. It is also likely that the gate prevents access to the mine by Common Bent-wing Bats.</p> <p>Threats to the orchids at the Ironbark Road Reserve. The reserve is less than 2 ha and is one of the best known orchid areas in NEM. Unmanaged visitor pressure has already led to the elimination of some species through trampling and weed invasion. Visitors comb the entire hill in search of orchids and trampling of non-flowering plants is evident. This activity could eliminate populations of several rare species. The reserve contains Ironbark Road on the west side and a vehicle track on the east side. The area to the east is undergoing residential development. In time the reserve may well be surrounded by houses, which would lead to the same problems currently occurring in the St Helena site. Weeds, including Large Quaking-grass and Panic Veldt Grass, are spreading throughout the reserve. Montpellier Broom has established in several areas and is looming as a serious threat. Boneseed and Freesias have also established. Rubbish dumping has occurred.</p>	<p>Weld-mesh gate for the Golden Stairs Mine. A gate of appropriate design should be installed to reopen access for bats to the mine. This is in the interests of human safety and bat conservation. Back-filling of the mines would close-off both a significant heritage chapter and a rare faunal species. The mine needs to be protected.</p> <p>Protection and management of the Ironbark Road Reserve orchid flora. The reserve is the most significant orchid area under ownership/management of the Shire of Nillumbik. It was fenced by the Shire in 1993. If bushland to the east of the St Helena Flora Reserve is subdivided for housing, the Ironbark Road Reserve will be the last representative orchid area remaining in the management unit. The reserve will require intensive management to maintain the present orchid assemblage (see the Dunmoochin and Kangaroo Ground–St Andrews Road Red Ironbarks sites). Removal of Large Quaking-grass, Panic Veldt Grass, Boneseed and Montpellier Broom is urgently required. The orchids must be viewed from existing tracks to avoid trampling. Continued survival of several of the rare species is seriously threatened. A management and recovery program for them is urgently required.</p>
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Managing and protecting the reserve

The orchid protection and management is dependent on co-operation and involvement from orchid lovers. So many people go to look at the orchids and so few do anything to protect them. The problems associated with loss of habitat and pollinators and increasing disturbance and weeds facing orchid colonies near Melbourne are considerable. Significant orchid areas closer to settlement such as between Research and Eltham have fallen to housing. Others remaining only in small reserves such as the Tindalls Road Reserve at Warrandyte and Yandell Reserve at Greenhills have fallen to weeds and disturbance. Action at Ironbark Road is required in two key areas:

The first area for action is land protection activity such as removal of Montpellier Broom, Boneseed and Freesias. Plan a working bee into the orchid visit. Develop a work plan and discuss it with the land managers (often local government in the situations of small bushland reserves near residential areas). Get involved with a local conservation group or an environment sub-committee of the local council. The mode of activity could range from an informal visitor group to a fully constituted 'friends' group. A small group visiting on a regular basis would deal with the shrubby weeds and some of the herbs at a place like Ironbark Road Reserve within 12 months. With a systematic approach the Large Quaking-grass and Panic Veldt Grass could be controlled within a few years.

The second area for action is documentation. Activities and information need to be resourced so that they are available for people awareness and education. Articles in group newsletters such as that produced by the Friends of Warrandyte State Park are an ideal forum for information. Write informed letters to local newspapers and politicians. There are over 50 threatened orchid species in Victoria. Flora and Fauna Guarantee Nominations and Action Statements are urgently required for most of them. This is a very big job. As a result, some of the Action Statements are being prepared on existing, often insufficient and out of date material.

Site 48 St Helena

Map Reference:	7922 359265 (St Helena Flora Reserve); 7922 352267 (Aqueduct Road Reserves); 7922 356284 ('windy mile' between the Old Diamond Creek Road and the Diamond Creek Road). One minute lat/long grids include 37° 40' x 145° 08' and 37° 41' x 145° 07' to 08'.
Location/Size:	bushland at St Helena Flora Reserve, along Aqueduct Road and on the 'windy mile' between the Old Diamond Creek Road and the Diamond Creek Road. Approximately 60 ha.
Municipality:	City of Banyule and Shire of Nillumbik.
Land Tenure/Use:	Public: St Helena Flora Reserve (City of Banyule); Open Space (blocks on the north side of Aqueduct Road west of Aqueduct Lane and south of Aqueduct Road between Dario Court and Tetragona Way). Private: proposed Residential (blocks north of Aqueduct Road and to the east of the St Helena Flora Reserve). Adjoining residential areas.
Landforms:	Foothill and alluvial/volcanic plain (see PLH C). Elevation is 80–105 m.

Scientific and Educational Values

Invertebrates. The type locality of the Eltham Copper butterfly was near St Katherines Church (Michael Braby pers. comm.). The species now appears extinct in the site. A few nests of a once substantial colony of the ant, *Notoncus capitatus* (known host of the Eltham Copper), still persist on the roadside of Aqueduct Lane. The ant is likely to die out in the location in the near future, as the butterfly did two decades ago. Consideration should be given to attempting to relocate one of the ant nests to another locality containing Sweet Bursaria in a more secure area (e.g. Plenty–Janefield site). If this were successful, translocation of Eltham Copper larvae from one of the known colonies could be then be considered.

Rehabilitation and management. The St Helena Flora Reserve has been the subject of a weed removal program and an extensive orchid rescue operation from surrounding development.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Red Box—Red Stringybark box—stringybark woodland (11.1; St Helena Flora Reserve)

Rare species: Emerald Greenhood

Critical assemblages or populations: Emerald Greenhood Critical Conservation Area: St Helena Flora Reserve supports the largest population (about 300 plants) known in GM

FAUNAL SIGNIFICANCE: Site 48 St Helena

Assessment: Regional—Category 1 (B, C, D, E)

Reference grids for the significance keys include:

48^a: 37° 40' x 145° 08'; 'windy mile', Diamond Creek Road

48^b: 37° 41' x 145° 07'; west section of Aqueduct Road/south to St Helena

48^c: 37° 41' x 145° 08'; St Helena Flora Reserve and east Aqueduct Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 48^b: the Eltham Copper butterfly persisted near St Katherines Church until about 1980

b. Vulnerable fauna

Regional. 48^c: 2 Swift Parrots in the bushland east of St Helena Flora Reserve on 24 October 1991 (the area is now housing)

c. Rare fauna

Regional. 48^c: Barking Owl and Common Dunnart at east section of Aqueduct Road near St Helena Road in 1991

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Regional. 48^c: 6 species in east section of Aqueduct Road on 14 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 48^c: 85 species

b. Native birds

Regional. 48^c: 68 species

c. Native mammals

Regional. 48^c: 6 species

d. Herpetofauna

Regional. 48^c: 11 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 48^c: 4 species

c. Regionally vulnerable fauna (R2 species)

Regional. 48^c: 2 species. **Birds:** Barking Owl. **Mammals:** Common Dunnart

e. Regionally depleted fauna (R4 species)

Regional. 48^c: 2 species. **Birds:** Peregrine Falcon, Swift Parrot, Rufous Songlark, White-winged Triller

f. Regionally restricted fauna (R5 species)

Local. 48^c: 4 species. **Birds:** Rainbow Lorikeet, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink

g. Nesting birds of prey/parrots

Regional. 48^c: Peregrine Falcon in a Sugar Gum along the old Maroondah Aqueduct at Aqueduct Road in October 1986

Outlook

Since the field work in 1991/92 the faunal significance would have declined from Regional Category 1 to 2 due to an inability of fauna in the habitat refugia to cope with the increasing level of urban development and impact from humans. The faunal groups most likely affected would be the forest birds, reptiles and ground mammals.

FAUNA

Rare or Threatened Fauna

Bb 48^c: Swift Parrot. Two were seen late in the season on 24 October 1991 in a Yellow Box in bushland between the St Helena Flora Reserve and Ryans Road. The habitat was Yellow Box–Candlebark valley forest (31.1). This area is now housing development. Habitat fragmentation and severance of habitat links by housing has caused the remnant bushland of St Helena Flora Reserve to become dominated by species of birds adapted to treed urban environments such as the Common Myna, Common Starling, Eastern Rosella, Noisy Miner, Rainbow Lorikeet and Red Wattlebird. The build-up in numbers of these competitive birds has reduced the suitability of the area for Swift Parrots.

Bc **48^c: Barking Owl.** One was heard at Aqueduct Road in an area proposed for development west of Aqueduct Lane on 14 November 1991. The habitat was Red Box–Red Stringybark box–stringybark woodland (11.1). This area was cleared in early 1993. One had been heard previously near the Montessori School (Meredith Sherlock pers. comm.). The species appears to have been eliminated from areas closer to Greensborough in the Diamond Valley by habitat and prey loss due to housing. The protection of remnant bushland along the east end of Aqueduct Road and north end of St Helena Road will be critical to the survival of the Barking Owl in the site.

Bc **48^c: Common Dunnart.** A nest of this species was located on 14 November 1991 in the block of Red Box–Red Stringybark box–stringybark woodland (11.1) on the north side of Aqueduct Road, west of Aqueduct Lane. This is adjacent to an area cleared for housing in early 1993. A dunnart that had drowned in a swimming pool was found earlier in 1991 near the Montessori School (Meredith Sherlock pers. comm.). This area contains a remnant strata of Red Box and native grassland understorey.

Aqueduct Road along with the Plenty Gorge at Yarrambat represent the innermost localities in the Shire of Nillumbik where the Common Dunnart is known to remain. Predation from cats and foxes would be a significant mortality factor. Protection of bushland in along the east end of Aqueduct Road and north end of St Helena Road will be critical for the survival of the dunnart in the site. A skull of a Black Wallaby was found in block of box–stringybark woodland west of Aqueduct Lane in 1991 and a road-kill was seen near the corner of Aqueduct Road and Diamond Creek Road in 1990. This species is no longer present in the site.

MANAGEMENT

Threatening Processes	Conservation Measures:
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Regional Habitat Link Strategy

Habitat connectivity. No effective habitat links remain. In 1986 bushland connected east from the St Helena Flora Reserve across Ryans Road and Murray's Hill to the Diamond Creek at North Eltham. This area is now housing.

<p>Decline of the Emerald Greenhood. The area of habitat and probable population of the greenhood in the Plenty Lowland Hills is about 5–10% of that surveyed in 1974, at the onset of modern urban subdivision. The St Helena–Greensborough area appears to have supported the main population of the species. Over 20 of the known populations were eliminated during this period. Fewer than 10 populations remain in the Plenty Lowland Hills and most are very small. They are isolated from each other and most suffer from high levels of perimeter disturbance and habitat fragmentation.</p>	<p>Emerald Greenhood Critical Conservation Area (see planning).</p> <p>Emerald Greenhood—management. The St Helena Flora Reserve contains the largest known population in GM (about 300 plants). It is now threatened in Victoria. Loss of habitat links and increasing disturbance from conflicting land-uses and surrounding residential areas present further difficulties. These deficiencies will have to be countered by an increased level of management.</p>
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St Helena Flora Reserve. Over 99% of the habitat of the St Helena orchid flora has been destroyed by urban development (less than 5 ha remains of an estimated 500 ha). Further habitat loss and degradation incurred from proposed urban development will place the orchid flora and critical population of the Emerald Greenhood in danger of extinction. With subdivision of the bushland to the east, the St Helena Flora Reserve (less than 2 ha) lacked effective habitat links and buffering from disturbance.

Unless there are strict controls on the level of access into the flora reserve plants will be trampled. The orchid flora is being eliminated at other small bushland reserves (e.g. Yandell Reserve). The scenario is the same for the Eltham Copper butterfly because insufficient habitat to secure viable, long-term populations was reserved from housing subdivision.

The long boundary of the St Helena Flora Reserve with disturbance and the effects of nutrient enrichment will change the soil chemistry to favour weeds. The weeds will continually invade from the residential areas due to inadequate buffering habitat. Weeds and nutrients will have a detrimental effect on the more selective and habitat dependent species of orchids such as the caladenia and diuris and their native pollinators. Ground disturbance and trampling of seedlings associated with the required intensive management activities such as hand pollination and weed removal may eliminate species. Weeds (e.g. Boneseed, Montpellier Broom, Large Quaking-grass, Panic Veldt Grass, Annual Veldt Grass) and vermin such as slugs and snails from the residential areas have the upper hand.

Clearing—forest habitat loss, fragmentation and disturbance. This site has suffered the most extreme degree of habitat loss and fragmentation of all sites in NEM over the last 15 years. The bushland surrounding the St Helena Flora Reserve has now gone. Domestic cats have had a noticeable effect on the native ground fauna and shrub layer birds. Ground fauna populations have been stranded by severed habitat links. Alien species that adapt to urban environments have prevailed. The vertebrate fauna diversity of the bushland has been substantially reduced from that preceding the onset of surrounding residential development 15 years ago.

Extension to the St Helena Flora Reserve. In 1994 about 2 ha of bushland was added to the flora reserve (extending it east to Liddesdale Grove). This area is considered the minimum required to counter the deleterious effects of fragmentation and habitat loss on the orchid assemblage. The area added to the flora reserve has high natural heritage values and significance for orchids. It contains a high diversity of species and one of the largest known populations of the rare Emerald Greenhood. It forms the most intact area of Red Box–Red Stringybark box–stringybark woodland remaining in the City of Banyule. The flora reserve is below the critical minimum size to maintain viable populations of all the orchid assemblage and buffer the effects of surrounding disturbance, unless intensively managed (see the Greenhills site for a review of the management problems in small urban reserves). Orchids in areas outside the reserve proposed for housing were salvaged and relocated into the reserve.

Retain/enhance habitat links in residential areas. Radiating habitat links from the St Helena Flora Reserve and other bushland refugias such as the ‘windy mile’ need to be retained or established. Bushland links north from St Helena Flora Reserve to Aqueduct Road are critical. Links also need to be provided through existing/proposed residential areas. Valuable bushland/links to the Diamond Creek on the east side of Ryans Road are being developed for housing. All existing bushland trees and understorey in the residential area should be retained. Indigenous vegetation should be enhanced in garden and street environments. This should be promoted through a public awareness program.

These stands of native vegetation habitat links need to be protected and further fragmentation of the bushland refugias needs to be prevented. Many of the forest stands (particularly the ‘windy mile’ bushland) are considered too small to support the populations of insectivorous birds required to maintain control over forest fragmentation-related eucalyptus dieback. Unless these stands are protected from further clearing many species of forest canopy insectivores will be eliminated.

Development of a strategy for conservation of remnant native vegetation in urban areas.

Eucalyptus dieback and the decline of bushland birds due to severance of habitat links.

Many of the bushland birds (e.g. Common Bronzewing, Brown Goshawk, Olive-backed Oriole, Buff-rumped Thornbill and White-winged Chough) will not persist as the bushblocks become more fragmented by development. Many species have been eliminated (e.g. Spotted Quail-thrush and Bassian Thrush). Stands such as the 'Windy Mile' on the Diamond Creek Road are particularly sensitive as they are already too small and are linear in shape.

Due to the encroachment of urban areas and the imbalance in forest edge habitat over internal forest habitat, they are dominated by urban and edge-inhabiting birds including the Noisy Miner, Common Starling, Common Myna and Spotted Turtle-Dove. Further habitat loss and habitat link fragmentation by clearing will lead to loss of forest birds and increased dieback in the bushland refugias.

Any further small loss in forest habitat or habitat links will likely result in large shifts in the imbalance and an escalating dieback problem. Another problem is that several local species of eucalypts (particularly Red Stringybark) are sensitive to earthworks which disturb the root system or alter drainage patterns. The stringybarks near existing earthworks at the Sawpit Gully end of the 'Windy Mile' have undergone crown dieback.

High rates of public use of remnant bushland areas. This indicates a necessity for retained bushland as well as open space. People need open space in urban areas. No small refugia of bushland used for intensive open space recreation has successfully maintained its population levels of species such as orchids over the long-term.

Need for community involvement and awareness in conservation practices at the St Helena Flora Reserve.

Removal of weeds such as the Large Quaking-grass is being conducted at the St Helena Flora Reserve. The ongoing effects of fragmentation aside, weeds and trampling loom as major threats to the orchids. A program of re-introducing indigenous shrub and wildflower species into the surrounding residential areas (house gardens and street plantations) should be instigated. Alien and non-indigenous native weeds (e.g. Sallow and Gawler Range Wattles) arising from the residential area are invading the bushland. The alien grasses, particularly Large Quaking-grass, Brown-top Bent and Cocksfoot are expanding. The conservation group formed at St Helena will need to tackle these weeds in the new section of the flora reserve.

St Helena Flora Reserve is a diverse and attractive wildflower area. Interpretation on the wildflowers (particularly orchids) would help protect them and perhaps stimulate community involvement. The bushland had become a major pedestrian access route for locals and a network of paths had established. The paths, which were sources of weed invasion and trampling, were eventually formalised into fenced trails. The public still needs to be made aware of the impact and likely long-term effect of uncontrolled pedestrian access on the wildflowers. Open space available for passive recreation will need to be provided in proposed residential development.

Other Issues

Dwindling orchid flora between Aqueduct Road and the 'windy mile'. In 1974, this area contained the most intact representative of the diverse and threatened St Helena orchid flora. The Aqueduct Road area is now engulfed by residential development and the orchids are being eliminated.

Orchid rescue operations from proposed housing development areas. This is conducted by members of the Australian Native Orchid Society. The society members conduct the operations in recognition of the value of these plants and the likelihood of habitat loss to housing. The orchids have been re-established in the St Helena Flora Reserve.

Proposed dual carriageway road construction along the ‘windy mile’. The Diamond Creek Road is proposed to be dual carriageway and the bends are to be straightened. Retention and enhancement of indigenous vegetation is highly desirable. With proposed development on the south side of the road there will be unbroken suburbia stretching from Greensborough to Diamond Creek. Alternative routes which minimise the impact on indigenous vegetation should be pursued.

The ‘windy mile’ wildflowers. As well as supporting significant and attractive ‘wildflowers’ (e.g. Hoary Sunray), this is the last bushland remaining along the main road between Greensborough and Diamond Creek. It is the only daily contact with bushland for many of the commuters in the Diamond Valley. The bushland on the higher side of the road will require management if the wildflowers (particularly orchids) are to remain. Many of the greenhood orchids are eaten by slugs. Weeds arising from the housing backing from the Old Diamond Creek Road need immediate attention.

Other problems on the ‘windy mile’. Extensive earthworks were conducted during service installations and the removal of fill for the roundabout above the lower section of the bends near Sawpit Gully. There was little follow-up rehabilitation management to control weed invasion and erosion. If the services extend through the bushland, little native vegetation of significance will remain. The bushland in the top section of the bends is wedged between the road and houses backing from the Old Diamond Creek Road. The small, linear strip of bushland is confronted with extensive perimeter disturbance and weed invasion. Montpellier Broom, Flax-leaf Broom, Grevillea hybrids, Cootamundra Wattle, Sallow Wattle, Panic Veldt Grass, Large Quaking-grass, Brown-top Bent, Paspalum and Kikuyu are spreading from the house gardens into the orchid areas. This has arisen largely from disturbance and uncontrolled runoff from the housing. The ‘windy mile’ bushland is frequently used by pedestrians and horse riders. The strip will be subjected to increasing pedestrian use and efforts (including fencing) should be made to confine this to the existing track.

Planning Recommendations

Conservation of the St Helena Flora Reserve. Specific habitat conservation guidelines and controls (in accordance with the Regional Habitat Link Strategy) are needed. Any further loss or degradation of habitat within the St Helena bushland can be directly equated to loss in orchid species. A full and satisfactory Environmental Impact Assessment should be presented and independently assessed before any future clearing proposal should be considered. The minimum boundaries comprise the St Helena Flora Reserve (hill-crest). Unless the flora reserve is appropriately managed, the extinction of the St Helena orchid flora is imminent.

Emerald Greenhood Critical Conservation Area. The most critical requirement for nature conservation in the site is the designation of an Emerald Greenhood Critical Conservation Area. This area comprises the St Helena Flora Reserve (and recent extension). The Regional Habitat Link Strategy contains specific guidelines for the retention and enhancement of the most critically important stands (and their indigenous understorey vegetation) of threatened habitats in NEM or populations of a rare or threatened species in Victoria. These are designated Critical Conservation Areas (CCAs).

The Emerald Greenhood CCA consolidates the main population of the greenhood in the site under conservation management. The strategy requires the protection of all CCAs in NEM and stronger conservation controls to

appropriately manage their designated biological values. Any proposed permit for subdivision in the CCA would require a full Environmental Impact Assessment.

PLH D ELTHAM

This management unit consists of one site of state faunal significance (site 49) and four sites of regional faunal significance (sites 50, 51, 52 and 53) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 363230 to 7922 372270 (Diamond Creek).

Location/Size: The Diamond Creek and adjacent catchments from Dalton Street Eltham to Allendale Road Eltham North. Approximately 1150 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. The hills in the vicinity of Eltham have constricted the Diamond Creek floodplain above its confluence with the Yarra River. The creek floodplain immediately upstream in the Diamond Creek site is more extensive. The unit is a meeting point for a number of biophysical zones. The Plenty Lowland Hills extend to the west and north, to the north-east is the Nillumbik Lowland Hills and to the east, separated by the Reynolds Road ridgeline, is the Yarra Lowland Hills.

Landforms

Foothill: hill-crests, hill-slopes, gullies, valleys, stream, creeks and dams. Alluvial plain (minor occurrence): plain-slopes and stream floodplain. Two gold-mines (Allendale Road Mine and Murray's Mine). Elevation is 30-105 m.

Hydrology

The Diamond Creek is perennial and contains slow-moving and deep open water pools and faster-moving rocky/sandy riffles. The pools in sections above Edendale Farm are about 1.5 m deep and contain submerged logs, emergent snags and mudbars. Most of the tributary creeks have been barrel-drained or contain weirs and retarding basins.

Rainfall: 660 mm.

Site 49 Eltham Copper Butterfly Reserves

- Map Reference:** 7922 387242 (Diosma Rd Eastern Colony); 7922 385242 (Diosma Rd Western Colony); 7922 382238 (Pauline Toner Reserve). One minute lat/long grids include 37° 42' x 145° 10' and 37° 43' x 145° 09'.
- Location/Size:** Bushland along Diosma Road and Eucalyptus Road Eltham. Approximately 40 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Pauline Toner Butterfly Reserve (NRE) and Diosma Road Reserves—Eastern and Western Colonies (NRE/Shire of Nillumbik); Woodridge Linear Park (Shire of Nillumbik). Private: bushblocks and encroaching residential areas.
- Landforms:** Foothill (see PLH D). Elevation is 60–110 m.

Scientific and Educational Values

Rehabilitation and management. Pauline Toner Reserve is managed by Warrandyte State Park. The Friends of Warrandyte State Park also undertake weeding and other management activities in the reserve.

Public interpretation. Display and trails at Pauline Toner Reserve.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference stands: nil

Relatively intact and extensive stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2; Toner Reserve)

Vulnerable species: Wine-lip Spider-orchid

Critical assemblages or populations: Eltham Copper Critical Conservation Area. Sweet Bursaria habitat of the Eltham Copper butterfly

FAUNAL SIGNIFICANCE: Site 49 Eltham Copper Butterfly Reserves

Assessment: State—Category 3 (B, F); Regional (C, D, E)

Reference grids for the significance keys include:

49^a: 37° 42' x 145° 10'; Diosma Road Eltham Copper Butterfly Reserves

49^b: 37° 43' x 145° 09'; Pauline Toner Butterfly Reserve

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 49^{ab}: Eltham Copper butterfly

b. Vulnerable fauna

State. 49^b: Large Ant-blue butterfly

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 49^a: 5 species including the Shining Bronze-Cuckoo, Rufous Whistler and Olive-backed Oriole at Diosma Road on 28 September 1987

k. Frogs

Local. 49^a: 5 species at Diosma Road on 28 September 1987

i. Arboreal mammals

Local. 49^a: 3 species including the Sugar Glider at Diosma Road on 28 September 1987

I. Reptiles

Regional. 49^b: 6 species including the Tree Dragon, Delicate and Weasel Skinks and Lowland Copperhead at Diosma Road on 28 September 1987

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Local. 49^a: 59 species

b. Native birds

Local. 49^a: 44 species

c. Native mammals

Local. 49^a: 4 species

d. Herpetofauna

Regional. 49^a: 11 species

e. Butterflies

Regional. 49^b: 21 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 49^a: 2 species. **49^b:** 2 species

b. Regionally endangered fauna (R1 species)

Regional. 49^b: 2 species. **Butterflies:** Large Ant-blue, Eltham Copper

Regional. 49^a: 1 species. **Butterflies:** Eltham Copper

e. Regionally depleted fauna (R4 species)

Local. 49^a: 1 species. **Birds:** Speckled Warbler

f. Regionally restricted fauna (R5 species)

Local. 49^a: 3 species. **Birds:** Rainbow Lorikeet, White-winged Chough. **Reptiles:** Delicate Skink

Local. 49^b: 1 species. **Butterflies:** Phigalia Skipper

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 49^{ab}: Eltham Copper Critical Conservation Area. The Diosma Road Eastern Reserve and Pauline Toner Reserve support the largest known populations of the Eltham Copper butterfly in GM

Outlook

The faunal significance of the site is dependent on the survival of the Eltham Copper and Large Ant-blue butterflies. Clearing of bushland in 1989 eliminated the regionally significant reptilian values.

FAUNA

Rare or Threatened Fauna

Ba 49^{ab}: Eltham Copper butterfly. The subspecies (*Paralucia pyrodiscus* ssp. *lucida*) is endangered in Victoria and Australia (Douglas 1995). The site is listed with state significance (rather than national) as the other subspecies (*P. p.* ssp. *pyrodiscus*) has a wide and disjunct distribution in eastern Australia and is considered secure nationally. There are four colonies of the Eltham Copper in the site: two at Diosma Road and one each at the Pauline Toner Reserve and on private land at Eucalyptus Road. The habitat of four of the six colonies in NEM is Yellow Box–Red Stringybark box–stringybark woodland (11.2). These include the Toner Reserve,

Eucalyptus Road and Diosma Road Western Reserve. The Diosma Road Eastern Reserve is Red Box–Red Stringybark box–stringybark woodland (11.1). This sub-community replaces 11.2 on Silurian mudstone hill-crests to the east. The butterfly only occurs with Red Box in areas where sandstone and mudstone overlap.

Over the decade since their discovery, the colonies have remained sedentary. They accompany clumps of usually several dozen dwarf Sweet Bursarias on well-drained, upper hill-slopes and hill-crests. The sites contain an open cover of shrubs including the bursaria and Golden and Gold-dust Wattle. The most frequent species in the ground layer are Grey Tussock-grass and Kangaroo Grass.

Eltham Copper larvae live in a specialised and interactive relationship with a nocturnal ant, known as *Notoncus capitatus*. The ants excavate a nest at the base of Sweet Bursaria in which the butterfly larvae shelters during the day. Larvae cling to the base of the stem or top of the main roots. At night the ants guard the larvae from predators and guide their movements. The ants obtain sugar and amino acid secretions from the dorsal organ of the larvae. The larvae develop for eight to ten months (the first generation from about January to October) and then pupate (for about 25 days; Michael Braby pers. comm.), attached to the underground part of the stem of the bursaria.

The presence of ant nests amongst the roots has some role in controlling the condition of water stress on the plant. The leaves of grazed bursaria plants are invariably limp, compared to those without ants and butterfly larvae. The water stress causes a break down of leaf nitrates to nitrogen and remobilisation of starch into sugars, apparently necessary for the butterfly larvae. This is not unlike the conditions operating between leaf psyllids and River Red Gum in dieback situations. Grazing during autumn causes upper plant foliage to die. New foliage appears after autumn rains for the main larval feeding period in winter. Bursarias can become defoliated when grazed by several larvae. A growth flush occurs in spring while the larvae pupate, usually inside the ant nests. Repeating cycles ‘dwarf’ the plant and maintain the foliage in a juvenile growth stage.

The adult butterflies emerge from early December to early February, peaking around Christmas/New Year. Individual butterflies would normally live for several weeks. In some years there is a second emergence in March (fewer numbers than the first). The white eggs are laid singly or in small groups, mainly on the lower portion of the bursaria stem near the entrances of the attendant ant nests, but also on the upper stem, branches and leaves. These hatch in about 12 days (Michael Braby pers. comm.).

Adults are relatively small, with a wing-span of about 25 mm. There is a broad window of shining copper-orange scales in the middle of the upper surface of the hindwing and forewing, framed by solid brown margins. Special scales known as sex-brands in the windows on the forewings of males are thought to emit pheromones (chemical that attract females). The males have small tails at the rear of the hindwings. Lycaenid butterflies move quickly when in the open between plants, the coppers fly rather jerkily. The windows flash under certain angles of sunlight.

When the butterflies land and fold their wings, the cryptic colouration and markings on the underside blend into the background, making them relatively inconspicuous. Adults bask in sunshine amongst the open grass and litter in the morning, and undisturbed they may open their wings. They take cover amongst shrubs in hot or windy conditions. They are most frequently seen flying in the middle part of sunny days when conditions are warm and still. When males take to flight, they cartwheel around each other in territorial chases.

Bb 49^b: Large Ant-blue butterfly. A male was observed amongst flowering Sweet Bursarias in bushland south of the Toner Reserve in January 1989 (Michael Braby and Fabian Douglas pers. comm.). A colony of the presumed attendant ant (*Papyrius* sp. *nitidus* complex) was located in the Toner Reserve in November 1993. This is a larger species than that located at other ant-blue colonies. It is not known from elsewhere in NEM. The habitat of the ant colony is Yellow Box–Red Stringybark box–stringybark woodland (11.2).

Critical Assemblages or Populations

Fb 49^{ab}: Eltham Copper butterfly. The Diosma Road Eastern and Western Reserves and Pauline Toner Reserve support the largest known populations of the Eltham Copper butterfly in GM. Following a major recommendation of the Management Plan for the Eltham Copper Butterfly (Vaughan 1988), the Invertebrate

Survey Section of the Museum of Victoria has conducted larval and adult (flight season) counts of the three colonies since 1993 (van Praagh 1996; Beverley van Praagh pers. comm.).

The 1994/95 mid-flight season counts (late December/early January) averaged 16 at the Toner Reserve, 40 at the Diosma Road Western Reserve and 28 at the Diosma Road Eastern Reserve. Comparable numbers were recorded from counts in 1995/96. Total populations are estimated to be at least twice the numbers, as a proportion of the adult population is likely missed during the count. Also butterflies recorded in early season counts would be different individuals from those recorded in late season. On comparison with counts made by the Eltham Copper Butterfly Friends Group since 1991, numbers at all three reserves appear to have remained stable over the last five years. Larval counts fluctuate at sites much more than the adult counts and data analysis at this early stage is inconclusive.

Other Significant Fauna

Birds

49^a: Diosma Road bushland prior to residential development. The data was compiled from a 2 hour visit to Diosma Road on 28 September 1987 before the onset of extensive development. The area covered included what is now the Eastern Reserve (Red Box–Red Stringybark box–stringybark woodland; 11.1) and the Western Reserve (Yellow Box–Red Stringybark box–stringybark woodland; 11.2). Fifty nine species of native birds were recorded. The bushland contained species that are common in larger blocks of bushland throughout the Nillumbik Shire. Several are scarce or absent from urban areas (e.g. Australian Owlet-nightjar, Scarlet Robin, Speckled Warbler and White-winged Chough). Most (if not all) of these have been eliminated from the site. The Speckled Warbler, largely a ground-dwelling bird, is a character species of box–stringybark woodland. The Brown Goshawk still nests in the area.

Reptiles

49^a: Diosma Road bushland prior to residential development. Six reptile species including the Tree Dragon, Delicate and Weasel Skinks and Lowland Copperhead were recorded in a 2-hour visit to Diosma Road on 28 September 1987. The dragon and copperhead are now probably locally extinct.

Butterflies

49^b: Pauline Toner Reserve. A relatively intact stand of Yellow Box–Red Stringybark box–stringybark woodland (11.2) is present on the exposed hill-slope. Other habitats in or adjacent to the reserve are degraded and fragmented. These include Red Stringybark herb-rich foothill forest (6.1; sheltered hill-slope), Swamp Gum gully woodland (10.3; gully) and Yellow Box–Candlebark valley forest (31.1; valley). In addition to the Phigalia Skipper, Large Ant-blue and Eltham Copper, locally significant species include the Dispar Skipper, Phigalioides Skipper, Wood White, Imperial White, Klug's Xenica, Shouldered Brown, Olane Azure, Common Imperial Blue, Common Dusky Blue and Double-spotted Line Blue.

49^a: Diosma Road Reserves. The Bright Shield Skipper and Common Dusky Blue were seen in 1987 at the Diosma Road Eastern Colony of the Eltham Copper (Michael Braby pers. comm.). The local food-plant of larvae of the Common Dusky Blue is the Downy Dodder-laurel. The range of the skipper in Victoria occurs mainly in the foothills in the east of the State. It is common between Pantom Hill and Christmas Hills but has become rare nearer Melbourne.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. No effective habitat links are present.

Statewide population decline and habitat loss of the Eltham Copper butterfly. The decline is attributed to extensive habitat loss due to agriculture and urban development. All known populations of the Eltham Copper in Victoria have become small and highly fragmented and the constituent colonies occur in geographically and biologically isolated stands of habitat (Braby *et al.* 1992). The Victorian range was scattered across the plains and foothills of central and western Victoria. This includes Kiata, Castlemaine and Tallarook in northern Victoria and Eltham–Greensborough, Broadmeadows and Keilor in southern Victoria (Douglas 1995).

Possibly over 95% of the suitable habitat within this range has been eliminated or substantially modified by land settlement and agriculture, particularly cropping and livestock grazing. Butterflies remain only at Kiata (declining population), Castlemaine and Eltham–Greensborough. The geographic range is now contracted and disjunct. All known colonies in Victoria appear to represent localised relics of a formerly more widespread and abundant population. Each is considered to be under threat.

Housing development had likely reduced the habitat of the butterfly at Eltham to stands fronting Diosma Road and Eucalyptus Road by the time of its discovery in 1986. Yellow Box–Red Stringybark box–stringybark woodland (and probably the Eltham Copper) occurred on Silurian sandstone hill-crests and exposed hill-slopes to the north-west of the present colonies. These stands were cleared in the 1970s with the Woodridge Estate subdivision. Similar vegetation closer to Eltham township had been long cleared.

Eltham Copper Butterfly Reserves. The Diosma Road population was discovered in January 1986. The site supported extensive stands of the larval food-plant (Sweet Bursaria) and a substantial population of the butterfly and attendant ant. This occurred largely on land proposed for residential development. The surrounding events over the following two years are documented by Vaughan (1988).

It became the first major attempt to secure a population of a threatened butterfly in Australia. The subspecies became one of the first invertebrates listed as threatened under Schedule 2 of the Victorian Government *Flora and Fauna Guarantee Act 1988*.

The developers provided a fence for the colonies and delayed subdivision while fund raising and public deputations to secure more land were conducted. Money raised from a public appeal and donations from Eltham Council and the State Government secured 2 ha in two blocks of bushland containing colonies of the butterfly at Diosma Road. The Pauline Toner Reserve was obtained by a government land transfer. Two reserves have been established. One is in two parts on Diosma Road (Western and Eastern) and the other (the Pauline Toner Butterfly Reserve) is on Eucalyptus Road. These are managed by NRE.

Eltham Copper Critical Conservation Area and Recovery Plan. The Critical Conservation Area contains the largest known population in GM. It encompasses four colonies dispersed in small and vulnerable areas of bushland amidst residential areas. The most intact sections of habitat in the site contain the butterflies. The intervening residential areas need to be incorporated under management in order to maintain the butterfly. The preservation of the bushland and butterfly colonies is critical to the conservation of the subspecies in Victoria.

'The decision on the species' survival around Eltham, in our present state of distributional knowledge, is fundamentally simple: without adequate reservation of the habitat of the major colonies, they are likely to go extinct' (New 1987).

The option that would have best ensured the survival of the major colonies at Diosma Road was to keep most of the 14 ha of bushland in its natural state so genetic exchange between the eastern and western colonies could continue (Crosby 1987). In 1989–90, over 12 ha was cleared and the two colonies became isolated by intervening housing.

Contrary to the expressed desire in the Eltham Copper Butterfly Management Plan (Vaughan 1987), this area now mostly lacks the Sweet Bursaria food-plant and, as far as is known, no longer supports the attendant ant and butterfly. A third (northern) colony, larger than the eastern and western colonies (possibly over 1000 butterflies), was located too late to preserve it from clearing. Around 40% of the copper butterfly habitat was lost to the subdivision. Insufficient land was reserved and the fragmented butterfly colonies in the site are facing changing environmental conditions. Disturbance is causing alien grass invasion and is probably altering drainage/soil moisture and nutrient conditions. Large populations of alien invertebrates (e.g. slugs, snails and millipedes) are present.

A steering committee was established. Members include officers from NRE and the Museum of Victoria and non-government entomologists. The major management objective of the committee has been the formulation of the Eltham Copper Butterfly Recovery Plan. The committee co-ordinates flight season surveys and larval counts at all major colonies. Without intensive management and protection of the colonies, the Eltham Copper is unlikely to survive in the long term. The recovery plan is formulated to reverse the extinction processes. It is now very important, given the possible scenario of population collapse, that an attempt is made to establish a new colony in a biological reserve within the known range/habitat of the butterfly (see Plenty–Janefield site), or at least to determine whether this is feasible.

Ecological research on the Eltham Copper.

Research is required on the interaction of the butterfly, ant and host plant at the reserves. The minimum objective of management is to maintain the remaining natural diversity, structure and integrity of the butterfly habitat. Management requires ongoing research and financial support. Data on the demography (size and extent) and fecundity (reproductive success) is needed at each of the colonies. Ecological relationships with the food-plant and behavioural relationships between the butterfly and the ant are poorly understood. The Museum of Victoria has been undertaking adult counts over recent flight seasons. Counts over 5–10 years are required to ascertain meaningful (possibly downward) trends. Research is needed on the impact of changing physical/biotic parameters (e.g. habitat link severance and disturbances).

Another unknown is the absence of a natural burning regime. The density of grass and litter at the Diosma Road Western Colony has increased. This may be contributing to an apparent decline in the butterfly/ant population through shading and dampness. A strip burn and ecological monitoring is proposed for a section of the colony (David Cameron pers.comm.). The burn needs to simulate a natural summer fire. This may temporarily eliminate the butterfly, but it should quickly recolonise the 'refurbished' habitat from adjoining unburnt areas (Michael Braby pers. comm.).

There is little effective habitat connectivity between each of the surviving colonies and possibly insufficient habitat area and butterfly, food-plant and attendant ant populations within these to ensure survival in the long-term. Each is surrounded by residential development and roadways and the colony areas lack sufficient buffering from disturbance to ensure long-term population viability. The ecological integrity of the habitat is being degraded. Colonies may require the ability to move locally, particularly if site conditions change (e.g. growth pattern of the bursaria, degree of dampness or shading). The lack of surrounding colonisable habitat may be the ultimate limiting factor to the survival of the Eltham Copper colonies. On the basis of habitat loss and degradation, it is likely that all the colonies will decline over time.

One aspect that provides some breathing space for the copper is that small colonies can persist in the short term on urban blocks. This can only occur under relatively favourable conditions including the retention of habitat for the butterfly/ant and intensive management such as weed removal and further planting of bursaria. However, it is considered improbable that these isolated colonies can survive indefinitely without the support of surrounding areas of colonisable habitat and habitat links to other colonies.

The information board at the Toner Reserve was established for interpretation of the butterfly, attendant ant and food-plant. It also hopefully stimulates community involvement and conservation awareness. The formalisation of paths and signs requesting users to refrain from walking in the bushland has assisted in habitat protection.

Weeds and housing disturbance at the Diosma Road butterfly reserves. The most serious weed is the Large Quaking-grass. Others include Montpellier Broom, Flax-leaf Broom, Boneseed, Sweet Vernal-grass, Annual Veldt Grass and Panic Veldt Grass. The road verges and property boundaries provide fronts for weed invasion. During construction of adjoining houses between 1990 and 1993, plastic bottles, cans and building rubble were dumped over the Diosma Road colony fences.

Need for community involvement to control weeds on the butterfly reserves. The ongoing effects of fragmentation aside, weeds and trampling present the main threats to the butterfly. Indigenous plant species should be systematically introduced into the surrounding residential areas (house gardens and street plantations). The Toner Reserve is also a significant wildflower area. Alien and non-indigenous native shrubs (e.g. Sallow and Gawler Range Wattles) arising from the residential area are entering the reserves. NRE target the woody weeds. A small workforce provided by the Friends of Warrandyte State Park is also involved in weed eradication. A small group known as the Friends of the Eltham Copper Butterfly also formed. A larger community group is required to assist with controlling the alien grasses, particularly Large Quaking-grass, Sweet Vernal-grass, Brown-top Bent and Cocksfoot.

Other Issues

Orchid decline associated with habitat loss, weeds and human disturbance. The Diosma Road area was almost as important for orchids as it was for the Eltham Copper. Within four years of subdivision the orchid diversity had almost halved. Of the surviving species at the butterfly reserves, the significant ones (11 of 22 species) are composed of scattered plants or small colonies. They are seriously threatened. The blocks are too small and disturbed for these species to persist. Most will be eliminated in time (as has happened at Hohnes Hill and Yandell Reserve). Unless intensively managed, weeds and associated slugs and snails and human trampling and disturbance will eliminate most of the remaining orchids.

Planning Recommendations

Critical Conservation Area of the Eltham Copper butterfly. The boundaries of the site represent the boundaries of the Critical Conservation Area. This area contains specific habitat conservation guidelines (in accordance with the Regional Habitat Link Strategy) and would require specific protection and management for the Eltham Copper butterfly. It should contain provisions for enhancing the habitat of the butterfly in the residential sections. Subdivision of land zoned Residential containing significant box-stringybark woodland understorey habitat (e.g. Sweet Bursaria or orchid flora) would require an Environmental Impact Assessment. The protection and enhancement of the box woodland habitat in the Critical Conservation Area is the utmost priority for the conservation of the Eltham Copper butterfly in NEM. No future subdivision of blocks containing significant bushland should be permitted. The negotiation of conservation covenants or similar conservation agreements as to the management of this bushland would be desirable. This should be accompanied by the development of a habitat protection incentive scheme.

Site 50 Eltham North

- Map Reference:** 7922 371253 to 7922 372270 (Diamond Creek). One minute lat/long grids include 37° 41' x 145° 09' and 37° 42' x 145° 09'.
- Location/Size:** The Diamond Creek from Wattle Tree Road bridge Eltham to Allendale Road Eltham North. Approximately 50 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: municipal parks/recreation reserves (Eltham North Reserve, Edendale Farm). Private: adjoining houseblocks. Creek flats formerly mixed farming, market gardens and orchards, now urban areas, open space and town parks.
- Landforms:** Foothill and alluvial plain (see PLH D). Elevation is 40–80 m.

Scientific and Educational Values

Rehabilitation and management. Edendale Farm.

Public interpretation. Edendale Farm.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or extensive stands: Manna Gum (floodplain terrace) riparian forest (5.2); Manna Gum (creek) riparian forest (5.3)

Notable features: The large Manna Gums of the creek and floodplain terrace at Eltham North Reserve support nest hollows for parrots and bats. Murrays Mine

FAUNAL SIGNIFICANCE: Site 50 Eltham North

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

50^a: 37° 41' x 145° 09'; Diamond Ck—Allendale Rd/Murrays Mine (same as **46^d**)

50^b: 37° 42' x 145° 09'; Diamond Creek—Eltham North Reserve/Edendale Farm

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 50^b: Regent Honeyeater (records from the late 1970s and in 1980)

b. Vulnerable fauna

Regional. 50^b: Swift Parrot (one sighting on 31 August 1990)

c. Rare fauna

Regional. 50^b: Eastern Broad-nosed Bat (trapped at Eltham North Reserve on 20 January 1991). Freshwater Blackfish were present in pools in the late 1960s

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 50^b: 6 species including the Sacred Kingfisher and Olive-backed Oriole at Eltham North Reserve on 10 October 1990

g. Breeding parrots

Regional. 50^b: 5 species including the Red-rumped Parrot and Rainbow Lorikeet at Eltham North Reserve on 10 October 1990

h. Bats

Regional. 50^b: 7 species taken in one harp trap at Eltham North Reserve on 20 January 1991

k. Frogs

Local. 50^b: 4 species including the Victorian Smooth Froglet at Eltham North Reserve on 27 March 1992

l. Reptiles

Local. 50^b: 4 species at Eltham North Reserve on 10 October 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 50^b: over 80 species

b. Native birds

Regional. 50^b: over 50 species

c. Native mammals

Regional. 50^b: 13 species

d. Herpetofauna

Regional. 50^b: 14 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 50^b: 8 species. **50^a:** 3 species

b. Regionally endangered fauna (R1 species)

Regional. 50^b: 1 species. **Mammals:** Eastern Broad-nosed Bat

c. Regionally vulnerable fauna (R2 species)

Regional. 50^b: 2 species. **Mammals:** Yellow-bellied Glider, Eastern Freetail Bat

Regional. 50^a: 1 species. **Mammals:** Common Bent-wing Bat

d. Regionally rare fauna (R3 species)

Regional. 50^b: 2 species. **Birds:** Pink Robin. **Reptiles:** Broad-shelled Tortoise

e. Regionally depleted fauna (R4 species)

Regional. 50^b: 3 species. **Birds:** Swift Parrot. **Mammals:** Platypus. **Frogs:** Bibron's Toadlet

Regional. 50^a: 2 species. **Birds:** Rainbow Bee-eater. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 50^b: 4 species. **Birds:** Nankeen Night Heron, Rainbow Lorikeet. **Reptiles:** Common Long-necked Tortoise, Delicate Skink

Local. 50^a: 1 species. **Birds:** Rainbow Lorikeet

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

Regional. 50^b: 10 Swift Parrots in Manna Gums at Eltham North Reserve on 31 August 1990

g. Rare/restricted colonial fauna

Regional. 50^a: 12 Common Bent-wing Bats at Murrays Mine on 20 January 1991

h. Other fauna

Regional. 50^b: 21 Yellow-tailed Black-Cockatoos along the creek by Edendale Farm on 20 October 1989. Five breeding pair of Rainbow Lorikeets in the Manna Gums at Eltham North Reserve on 10 October 1990. Red-rumped Parrot (20 birds at Eltham North Reserve on 31 August 1990; large population near eastern range-limit in NEM)

i. Bat trapping rate

Regional. 50^b: single trapping of 31 bats including the Eastern Freetail Bat (2 individuals) and Eastern Broad-nosed Bat (2 individuals) at Eltham North Reserve on 20 January 1991

j. Electrofishing rate

Local. 50^a: Short-finned Eel in the Diamond Creek behind Eltham North community centre on 13 April 1992

Outlook

The faunal significance may decline from the important Regional Category 1 to 2 without extensive conservation management including revegetation of the streamway and the severed habitat links both along the creek and overland through residential areas. A narrow strip of native vegetation fronts the creek but much of the creek bank is degraded and weed invaded and the terraces are cleared.

FAUNA

Rare or Threatened Fauna

Ba 50^b: Regent Honeyeater. Records from the 1970s and in 1980. None since.

Bb 50^b: Swift Parrot. Ten roosting in Manna Gums (5.3) at Eltham North Reserve on 31 August 1990. The creek from the Yarra to Wingrove Park (see Lower Eltham Park–Thomsons site) is their most important autumn-winter roost in NEM.

Bc 50^a: Common Bent-wing Bat at Murrays Mine. The mine lies at the foot of the creek escarpment amongst partially degraded and fragmented Manna Gum riparian forest (5.2) on the floodplain terrace and Red Stringybark herb-rich foothill forest (6.1) on the sheltered escarpment. Remnant Red Box–Red Stringybark box-stringybark woodland (11.1) occupies the hill-crest.

The mine supported up to 100 wintering bent-wing bats (Craig Smith pers. comm.). A dozen males were roosting in ceiling arches on 20 January 1991. Piles of droppings (guano) were located in the interior of the mine, indicative of usage by substantial numbers of bats. It is believed that Murrays Mine is one of a series of eight shafts known as the Allendale Mine. This was worked by several mining syndicates from 1873 to around 1900. The drive is 115 m long, at which point it is stoped (a ‘T’ with steepled ceiling forming the working face). The height of the drive is 1.6 to 2.0 m. The right hand of the ‘T’ leads to a second working face above which rises a ventilation shaft (back-filled at the surface). The drive entrance was back-filled in early 1992 (subsequently re-opened and gated in February 1994; see conservation measures) as it was undergoing increasing human visitation. The other shafts are back-filled.

The Common Bent-wing Bat is listed as rare in Victoria. Forest clearing and loss or disturbance to roost sites in recent decades may have led to a population decline. Females migrate in early summer to maternity caves in East Gippsland to breed. In early autumn they disperse over southern Victoria to ‘winter’ in caves. Smaller numbers of males remain at these through the year. The cave-bat colonises abandoned shafts from the gold mining operations of the late Nineteenth Century. Due to collapse or back-filling with urban advance, few intact mines remain, and the cave-bat has become regionally threatened.

Bc 50^b: Eastern Broad-nosed Bat. Two trapped at Eltham North Reserve on 21 January 1991.

Other Significant Fauna

Birds

50^b: Large Manna Gums—important for parrots. The Swift Parrot roost in Manna Gum riparian forest (5.2/5.3) at Eltham North Reserve on 31 August 1990 was shared by several other parrot species. Five species including the Red-rumped Parrot and Rainbow Lorikeet were breeding in the Manna Gum hollows on 10 October 1990. Flocks of 10-20 Red-rumped Parrots are frequently seen feeding on the lawns of the town parks. This species is uncommon in upstream sections of the Diamond Creek and is rare further east (e.g. Watsons Creek catchment) in NEM.

50^b: Upland avifauna corridor along creek. Several observations of upland birds have been made. These include a flock of 21 Yellow-tailed Black-Cockatoos feeding on tunneller larvae and wasp galls in the Manna Gums and Silver Wattles at Edendale Farm on 20 October 1989 and a Pink Robin in the Silver Wattles along the creek north at Eltham North Reserve on 10 August 1990. The creek vegetation consists of Manna Gum (floodplain terrace) riparian forest (5.2) and Manna Gum (creek) riparian forest (5.3). This is flanked by remnant Yellow Box–Candlebark grassy woodland (14.6) on the upper floodplain and valley of Wattletree Road. Remnant Red Box–Red Stringybark box–stringybark woodland (11.1) occupies the exposed hill-slopes of the residential area.

Mammals

Ec **50^b: Yellow-bellied Glider.** An animal was seen in Manna Gum riparian forest (5.3) along the Diamond Creek at Eltham North Reserve in mid-August 1993 (Glen Terry pers. comm.). This species disperses long distances. The riparian forests along the Yarra River, Diamond Creek and Watsons Creek are the likely routes connecting populations of the glider in the ranges (see the Watsons Creek–Yarra Ridge site). The glider appears to be making a recovery in NEM but this is dependent on protection and enhancement of habitat links along streams.

Ee **50^b: Platypus.** One was seen moving along the Diamond Creek (Manna Gum riparian forest; 5.3) near Edendale Farm on two occasions in August 1990. A disused burrow was located in the bank at Eltham North Reserve. They are no longer resident but appear to move along the creek in times of water flow from breeding areas at the confluence of the Diamond Creek and Yarra River. They are autumn-winter visitors upstream as far as the Diamond Creek site.

50^b: Large Manna Gums—important for bats. Provided large eucalypts are present, bats are the most diverse group of mammals in urban areas. A total of 31 bats comprised of 7 species was taken in one trap-night on 20 January 1991 at Eltham North Reserve. This is a high trap-night average and indicates that the mature Manna Gums present provide excellent tree-hollow habitat. The regionally threatened Eastern Broad-nosed Bat and Eastern Freetail Bat were both trapped. The bat trap was located amongst scrub and tall Manna Gums along a path on the floodplain terrace (riparian forest; 5.2)

Reptiles

Ed **50^b: Broad-shelled Tortoise.** The Broad-shelled Tortoise was recorded at the pond above the creek at Eltham North Reserve. The Broad-shelled Tortoise is derived from released individuals. Breeding populations are present along the Yarra River from Burke Road to upstream of the Diamond Creek confluence.

Freshwater fish

50^a: Electrofishing Survey: Diamond Creek behind Eltham North Community Centre

Map reference. 7922 369262. **Altitude.** 35 m. **Survey date.** 13 April 1992 and 9 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum (creek) riparian forest: (5.3; poor condition; woody and grassy weeds). Frontage: Manna Gum (floodplain terrace) riparian forest: (5.2; remnant) and Yellow Box–Candlebark grassy woodland (14.6; remnant)

Physical Features:

Pools

Substrate. Deep silt, logs, branches, urban flotsam and willow roots on sheet siltstone; channel scoured

Maximum size (mid-autumn). 5 m wide by 1.6 m deep by 50 m long

Riffles

Substrate. Gravel, boulders and cobble on sheet siltstone

Flow (mid-autumn minimum): Size. 4.0 m wide by 5 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 9.4 ML/day. About 40% fed from urban runoff

Flow (mid-winter normal): Size. 4.0 m wide by 40 cm deep. **Velocity.** 0.8 m/sec. **Rate.** 305 ML/day

Water quality

Autumn: Temperature. 16.0°C. **Conductivity.** 440 ms. **Salinity.** 0 ppt. **Turbidity.** High
Winter: Temperature. 10.5°C. **Conductivity.** 170 ms. **pH.** 6.9. **Dissolved Oxygen.** 11.4-11.8 ppm. **Turbidity.** High

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (1); migratory sub-adult

Alien species numbers/status. Roach (31); likely breeding resident. Goldfish (3); likely breeding resident

Other comments. The Short-finned Eel was the only native recorded. Roach first appeared in the 1970s. Goldfish and Mosquito Fish were seen in the adjacent pond above the creek. Fish were difficult to detect due to turbidity while electrofishing as the stream was high. The water was odorous and probably polluted and the substrate of the pools was heavily silted. Riparian field layer vegetation was predominantly exotic. Freshwater Blackfish and Redfin were present in the pool behind Dansey’s Store in the late 1960s (Ken Hughes pers. comm.). Creek ‘improvement’ of basalt boulders was undertaken to stabilise the banks during installation of a sewerage line. Platypus have been seen during winter passage. Land tenure: council reserve.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Partially intact riparian habitat links upstream to the Diamond Creek site and downstream to the Eltham township site. Ineffective links through recent housing development west to the St Helena site and east to the Wombat Drive–Piper Crescent Research and Eltham Copper Butterfly Reserves sites.</p>	
<p>Encroaching urban development—habitat link severance. The site no longer contains intact or extensive bushland. While remnant trees are still present in the residential areas the dominant birds are alien species. On a recent drive along Wattletree Road between Ryans Road and the Diamond Creek bridge, 60 birds of nine species were counted. Only two species and three individuals were native. Both the native species (Red Wattlebird and Rainbow Lorikeet) are common throughout suburban areas.</p>	<p>Green web park. All public lands from the Yarra River to Diamond Creek township should be incorporated into a green web park. This should be embraced under the Open Space 2000 initiative.</p> <p>Strengthen habitat links. See other sites in unit.</p> <p>Edendale Farm conservation works. See Edendale Farm Management Plan.</p>

 Regional Hydrological Strategy

Pollution and poor water quality. See Volume 1
Creek improvement schemes—flood mitigation and flow regulation. See Volume 1

Poor water quality and severe stream degradation. Diamond Creek has a high turbidity/siltation rate and mildly polluted water. There is an elevated summer flow rate due to urban runoff from adjacent and upstream residential areas. Loss of native riparian cover has led to severe bank erosion and slumping and tree and bank undercutting. This is largely due to bank disturbance from visitors. Several large Manna Gums fell during the wet winter-spring of 1992. Weeds have invaded and the stream contains urban rubbish and litter.

Require increased land protection and revegetation management works along the creek. Works undertaken along the Eltham North Reserve section include planting and Blackberry spraying. Extensive works have been undertaken at Edendale Farm. The upstream section from Murrays Mine to Allendale Road requires extensive work. The willows need systematic removal, but works must avoid further bank erosion as significant riparian vegetation could be eliminated (e.g. Common Rasp-fern). Target one tree in every three for poisoning and follow-up the remainder over a three-year period. The trees should not be removed. Follow up with planting shrubs such as Hazel Pomaderris. The Three-cornered Garlic needs control. Follow up with planting grasses such as Sword-Tussock-grass. Montpellier Broom infestations on the escarpment also require control.

Monitoring and adherence to water quality controls in Diamond Creek.

 Other Issues

Back-filling of Murrays Mine. The mine was undergoing increasing human visitation and was back-filled as it presented a potential danger to humans. This event in early 1992 was a loss to the natural heritage of the Shire of Nillumbik (see Golden Stairs Mine in the Plenty site). This was rectified with the reopening and gating of the mine in 1994.. As a result of an interview with a former resident in 1991 it was discovered that the mine supported Common Bent-wing Bats. The mine supported one of a most substantial winter roosts of the species in the Shire of Nillumbik.

Murrays Mine. The reopening and security gating of the mine has been an important step toward securing the long-term conservation of the Common Bent-wing Bat in NEM. The exercise will also raise awareness amongst the community of the heritage and conservation values of mines. The drive of Murrays Mine was re-opened on 22 February 1994 and installed with an entrance grill of specified design. This was undertaken by the Shire of Diamond Valley to prevent unauthorised human access to the mine, so allowing recolonisation by bent-wing bats. The cost of materials and labour for the project was estimated at \$2400. Reoccupation by the numbers of bats formerly present would give the mine State faunal significance. This is being monitored (nil present on 24 March and 25 April 1994). It may take some time for recolonisation to occur and consideration might be given to transferring bats from elsewhere to enhance the recovery (a scientific permit would need to be obtained from NRE).

The interior of the mine appears relatively sound and would normally be expected to have a long lifespan. Unlike most other mines in the district, there is no timber shoring, an indication that the miners considered the substrate stable. However, there have been several internal collapses of large rock slabs since the mine was reopened, due to the draining of a large volume of water dammed by the back-filling. It is inadvisable for the mine to be re-entered until this activity settles down. Some inner sections contain 30 cm of water on the floor. These areas are warm and humid. Other sections are dry and cold. The combination provides an ideal microclimate for cave-bats.

Pressure on streamway vegetation from heavy recreational use.

Protection and rehabilitation of the floodplain and adjacent bushland. Includes all areas within 100 m of the upper bank of Diamond Creek.

Site 51 Eltham Township

- Map Reference:** 7922 363230 to 7922 371253 (Diamond Ck); 7922 364248 (Scenic Cres Reserve). One minute lat/long grids include 37° 42' x 145° 08'.
- Location/Size:** The Diamond Creek from Dalton Street to Wattle Tree Road. Approximately 80 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: municipal parks/recreation reserves—streamside reserve. Private: adjoining houseblocks. Creek flats formerly mixed farming, market gardens and orchards, now school, commercial/residential areas, open space and town parks.
- Landforms:** Foothill and alluvial plain (see PLH D). Elevation is 30–100 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 3

Vegetation: degraded/fragmented Manna Gum riparian forest (5.3) and Red Stringybark herb-rich foothill forest (6.1); cleared/residential remnants of 5.2, 10.3, 11.1, 11.2, 14.6

FAUNAL SIGNIFICANCE: Site 51 Eltham Township

Assessment: Regional—Category 2 (D, E)

Reference grids for the significance keys include:

51^a: 37° 42' x 145° 08'; Diamond Creek—Eltham township

51^b: 37° 43' x 145° 08'; Diamond Creek—Bridge Street/Bolton Street

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 51^b: Regent Honeyeater. A sighting in Manna Gums along the Diamond Creek near Bridge Street and one in an ornamental flowering gum (*Eucalyptus ficifolia*) in a suburban garden in the late 1970s at Cromwell Street. They were relatively frequent visitors to the Eltham township. Icilius Blue butterfly (late 1940s; locally extinct)

b. Vulnerable fauna

Unranked. 51^b: Ictinus Blue butterfly (early 1960s; locally extinct)

c. Rare fauna

Unranked. 51^b: Common Bent-wing Bats (Judge Book stormwater tunnel in the early 1970s; no longer present). Rare White-spot Skipper butterfly (late 1940s; locally extinct)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Unranked. 51^a: 4 species including the Victorian Smooth Froglet and Bibron's Toadlet at the Scenic Drive Reserve on 26 April 1989

l. Reptiles

Unranked. 51^a: 5 species along the Diamond Creek between Judge Book Village and Scenic Drive Reserve on 31 March 1992. These included the Southern Water Skink, Delicate Skink, Tiger Snake and Common Blue-tongued Lizard

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 51^a: over 70 species

b. Native birds

Regional. 51^a: over 50 species

c. Mammals

Local. 51^a: 5 species

d. Herpetofauna

Regional. 51^a: 12 species

f. Butterflies

Regional. 51^b: 23 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 51^a: 2 species

e. Regionally depleted fauna (R4 species)

Regional. 51^a: 2 species. **Birds:** Australian King-Parrot. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 51^a: 3 species. **Birds:** Rainbow Lorikeet, Purple-crowned Lorikeet. **Reptiles:** Delicate Skink

Local. 51^b: 3 species. **Butterflies:** Meadow Argus, Dark Purple Azure, Chequered Blue

Outlook

Faunal species are mostly those tolerant to relatively high degrees of habitat loss and degradation or passage birds moving along the creek. Degradation of the streamway habitat and severance of overland habitat links has resulted in substantial declines in native species over the last decade. Apart from remnant eucalypts in housing areas, the only relatively extensive stands of indigenous habitat that remain front the Diamond Creek, but these are degraded. The best section occurs immediately downstream of Wattletree Road bridge.

FAUNA

Rare or Threatened Fauna

Bc 51^a: Former Common Bent-wing Bat colony in the Judge Book stormwater tunnel. The bats occupied the stormwater tunnel outflowing at Judge Book Village in the 1960s (Craig Smith pers. comm.). This was searched in March 1992 but there were no signs of occupation. The creek outlet is polluted and the banks are infested with blackberry and harbour substantial populations of Black Rats. The environment now appears inhospitable to cave-bats. Provided stormwater tunnels are not disturbed by humans and natural habitat occurs nearby, roost sites may occur elsewhere in drains under Melbourne. Common Bent-wing Bats as these were trapped in the Melbourne botanic gardens probably roost in stormwater tunnels lined with bluestone pitchers entering the Yarra River.

Other Significant Fauna

Birds

51^a: Parrots in the remnant bushland along the creek. The vegetation consists of Manna Gum (floodplain terrace) riparian forest (5.2) and Manna Gum (creek) riparian forest (5.3). This is flanked by Yellow Box–Candlebark grassy woodland (14.6) on the upper floodplain and valley (township area). Stands of Red Stringybark herb-rich foothill forest (6.1) occupy the sheltered creek escarpment (e.g. Scenic Drive Reserve). 5.2 and 14.6 are degraded or cleared.

Rough nature strips and playing fields containing seeding clovers and Prostrate Knotweed in the Eltham township are feeding areas for Red-rumped Parrots. The ornamental flowering trees and Manna Gums provide nectar for lorikeets. The Rainbow Lorikeets which breed nearby at Wingrove Park move through the trees along the creek. The Purple-crowned Lorikeet was seen feeding in a flowering Manna Gum along the creek near the Railway Parade swing bridge on 31 March 1992. The mature Manna Gums, Candlebarks and Yellow Box may

provide nesting habitat for the Red-rumped Parrot, Musk Lorikeet and Rainbow Lorikeet. Several upland birds were recorded in the Scenic Drive Reserve in April 1989. They move through the area to the Yarra River from upland breeding grounds during autumn. These included Gang-gang Cockatoos (feeding on fruiting Hawthorns) and the Australian King-Parrot and Yellow-tailed Black-Cockatoo.

51^a: Birds of the Scenic Crescent Reserve. The Buff-rumped Thornbill, Crescent Honeyeater, White-eared Honeyeater and Jacky Winter were present in the reserve between the creek and Scenic Drive when visited on 26 April 1989. The Jacky Winter was in the Manna Gums and Narrow-leaf Peppermints on the west side of the creek near the swing bridge.

51^b: Eltham Central Park waterbirds. The pond supports over 50 Pacific Black Ducks. Other common waterbirds include the Dusky Moorhen.

Reptiles and frogs

51^a: Scenic Crescent Reserve. Seven reptile and five frog species were recorded. The creek supports a moderate diversity of reptiles. On 31 March 1992, a Southern Water Skink was seen by the creek in Manna Gum riparian forest (5.3) and a Delicate Skink and Weasel Skink were recorded on the sheltered escarpment under Red Stringybark herb-rich foothill forest (6.1). The locally scarce Victorian Smooth Froglet and Bibron's Toadlet were both recorded on 26 April 1989. The froglet was calling during the day. The toadlet was located under leaf litter on the sheltered hill-slope. Both the Common and Blotched Blue-tongued Lizard were recorded.

Butterflies

51^b: Eltham township. Twenty three species (presumed to breed locally) have been recorded in the Cromwell Street area (Michael Braby pers. comm.). The large houseblocks support remnant Yellow Box–Candlebark grassy woodland (14.6). Regionally restricted species include the Meadow Argus, Dark Purple Azure and Chequered Blue. Locally significant species (seldom recorded in the urban area) include the Dispar Skipper, Bright Shield Skipper, Symmopus Skipper, Klug's Xenica, Olane Azure, Common Imperial Blue and Double-spotted Line-Blue. The vagrant Chequered Swallowtail and Small Grass Yellow (an inland species seen during an irruption in November 1988) have also been recorded.

Eltham township was frequented by butterfly collectors between the 1940s and 1960s. Stands of Yellow Box–Red Stringybark box–stringybark woodland (11.2; now only scattered trees) stretched east from above Main Road to the present Eltham Copper Butterfly Reserves at Diosma/Eucalyptus Road. Threatened inland box–stringybark woodland species recorded include the Rare White-spot Skipper, Ictinus Blue and Icilius Blue (Michael Braby and Fabian Douglas pers. comm.).

The Icilius Blue was recorded in the late 1940s by E.G. Harris (Michael Braby pers. comm.). This species is only known to survive in GM in the Plenty–Janefield site. The Rare White-spot Skipper was recorded in the late 1940s by Alex Burns (Michael Braby pers. comm.). There are only two recent records in GM (Plenty–Janefield and Nutfield). The latter was from Yellow Box–Red Stringybark box–stringybark woodland (11.2) at Nutfield in November 1988 (Nigel Quick pers. comm.). The Ictinus Blue was recorded near Eltham Primary School in the early 1960s, where it bred on Early Black Wattle (Fabian Douglas pers. comm.).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Partially intact riparian habitat links upstream to the Eltham North site and downstream to the Lower Eltham Park site. Ineffective links through housing development west to the Meruka Park site and east to the Eltham Copper Butterfly Reserves site.</p>	
<p>Encroaching housing development—habitat loss and link severance. Koalas and native ground mammals are unlikely to move through the site from the Yarra to areas upstream because of road crossings and loss, constriction and fragmentation of habitat links. These links and the creek habitat and water quality will continue to decline as development proceeds nearby and further up the catchment.</p> <p>Poor water quality of stormwater runoff. Problem areas include hard rubbish and nutrient, detergent and motor oil emissions in street runoff, illegal connections of sewerage lines to stormwater in new developments, and industrial effluent.</p>	<p>Strengthen habitat links. The creek requires extensive land protection management. It is decidedly the weak biological link in the Diamond Creek system. Downstream at Wingrove Park, works have been conducted and the riparian vegetation is of better quality. The area supports a higher faunal diversity because of the link to the Yarra. Upstream at Edendale Farm the creek is being restored. The town section has become very degraded and neglected. The Yarra fauna will not return upstream unless the town link can be restored. Incorporation of the Eltham Township site into a 'green web' park and appropriate conservation works are viewed as major priorities.</p>
Regional Hydrological Strategy	
<p>Weed invasion of the creek bank. Weeds are the major problem, particularly Blackberry and creepers such as English Ivy, Periwinkle, Cleavers, Wandering Jew and Japanese Honeysuckle. The ivy has ringbarked many of the old Manna Gums where it grows along the creek. Introduced grasses occur where the creepers haven't spread.</p>	<p>Improve water quality of the creek. The instream habitat and water quality of the creek in the town section is still good enough to enable migratory movements of native instream fauna, but few species reside there. Weed removal and extensive replanting along the streamway would improve the situation. Measures to improve the water quality of stormwater outfall need to be considered (e.g. hard rubbish traps in street drains).</p>

Site 52 Meruka Park

Map Reference:	7922 355245. One minute lat/long grids include 37° 42' x 145° 07'.
Location/Size:	Karingal Drive Montmorency. Approximately 30 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: parkland (Shire of Nillumbik). Private: adjoining houseblocks and areas under housing development.
Landforms:	Foothill (see PLH D). Elevation is 40–80 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or extensive stands: Yellow Box–Candlebark grassy woodland (14.6)

Vulnerable species: Clover Glycine (possibly eliminated by weeds, slugs and trampling; could not be located during surveys in 1989/90)

Notable features: the large Candlebarks support parrot nest hollows

FAUNAL SIGNIFICANCE: Site 52 Meruka Park

Assessment: Regional—Category 3 (B, D)

Reference grids for the significance keys include:

52^a: 37° 42' x 145° 07'; Meruka Park, Eltham

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

Unranked. 52^a: Regent Honeyeater: 2 birds seen in December 1980; not recorded since

b. Vulnerable fauna

Regional. 52^a: Swift Parrot (two feeding on leaf psyllids in a Yellow Box in the urban area opposite the park on the west side of Karingal Drive on 21 April 1988)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 52^a: 5 species including the Sacred Kingfisher, Tree Martin and Olive-backed Oriole on 8 November 1989

g. Breeding parrots

Local. 52^a: 3 species including the Red-rumped Parrot and Eastern Rosella on 8 November 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Regional. 52^a: over 50 species

c. Native mammals

Local. 52^a: 2 species

d. Herpetofauna

Local. 52^a: 7 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 52^a: 1 species

e. Regionally depleted fauna (R4 species)

Local. 52^a: 1 species. **Birds:** Swift Parrot

f. Regionally restricted fauna (R5 species)

Local. 52^a: 2 species. **Birds:** Rainbow Lorikeet. **Reptiles:** Delicate Skink

F. POPULATION DENSITY: Viability and Abundance—point census

o. Regionally restricted fauna (R5 species)

Local. 52^a: 6 Delicate Skinks recorded in 60 minutes searching on 8 November 1989

Outlook

The faunal significance declined from State through Regional Category 1 to 3 between 1975 and 1990 due to severance of habitat links and internal habitat degradation. With surrounding housing development since 1990, faunal diversity has likely further declined. In 1975, relatively intact bushland in the area covered almost 100 ha. This had been reduced to about 10 ha by 1990 and 5 ha by 1996. Most of the fauna species are those adapted to semi-urban environments. These should remain if management prescribed under conservation measures is undertaken. The faunal diversity (e.g. reptiles) will otherwise continue to decline.

FAUNA

Rare or Threatened Fauna

Ba 52^a: Regent Honeyeater. This species was last seen in December 1980 (2 birds; Joy Pagon pers. comm.). This was also the year of the last sighting of the species at Diamond Creek (near Fyffe Street) and Eltham (near Cromwell Street). Regent Honeyeaters were frequently seen up to this time along the Diamond Creek between Eltham and Cottles Bridge.

Bb 52^a: Swift Parrot. Two were seen feeding on leaf psyllids in a Yellow Box in the urban area opposite the park on the west side of Karingal Drive in April 1988.

Other Significant Fauna

Birds

52^a: Meruka Park. The bird list was compiled from visits in 1989/90. It contains several bushland species which are rare or absent from inner NEM. These include the Common Bronzewing, Sacred Kingfisher, Striated Thornbill, Rufous Whistler, Eastern Yellow Robin, Olive-backed Oriole, Fan-tailed Cuckoo, Grey Shrike-thrush, Yellow-faced Honeyeater, Tree Martin, Dusky Woodswallow and White-naped Honeyeater. Adjacent subdivision in the early 1990s probably eliminated several of these species. The faunal diversity of the park had declined appreciably since first visited in 1975. Some of the above forest species which were locally common had become rare by 1990.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective habitat links remain. There are fragmented links for birds via residential areas south to the Lower Eltham Park site, west to the Greenhills site, east to the Eltham Township site and north to the St Helena site.</p>	

Loss and fragmentation of habitat links.

Clearing bushland for housing upstream and to the east has severed the last effective habitat links for ground fauna. Loss of species has resulted. Populations of Noisy and Bell Miners have increased and dieback of Swamp Gums is escalating.

Rehabilitation and management. Meruka Park is one of few reserves in the inner section of the Shire of Nillumbik containing significant native bushland. The area has been transformed from bushland to urban in the last two decades and Meruka Park is one of the few survivors of a landscape that once characterised 'Eltham'. In the process, the bushland at Meruka Park has become degraded and fragmented and requires extensive rehabilitation.

Conservation program for the park and adjacent private land and formation of a friends group. Land protection activities by landowners should be developed. A community 'friends of Meruka Park group' should form to coordinate land protection and awareness exercises.

 Regional Hydrological Strategy

Creek degradation and pollution. The creek is degraded and the water is polluted. Weeds (Blackberry, Montpellier Broom and Boneseed) and vermin (Common Blackbirds and Black Rats) are abundant.

Damage from riders and livestock. Riding and walking paths near the creek have caused soil disturbance and weed invasion. Prior horse grazing has damaged most of the gullies.

Protection of the streamway. This should follow the principles outlined in the Regional Habitat Link and Hydrological Strategies (Volume 1). The creek is degraded and neglected and requires an intensive weed eradication and revegetation program.

 Conservation Measures for Other Issues

Interpretation facilities, nature trails and revegetation areas. Meruka Park should be developed as a nature conservation and interpretation area through the provision of nature trails. These could be used to direct visitor use away from sensitive conservation and revegetation areas. Most bushland in urban parks in Eltham and Greensborough has a poor public image. There is need for community participation, yet little is undertaken. With 10 or 20 active members in a weed eradication and tree planting group the Montpellier Broom and Boneseed could be removed and replaced by showy (and purposeful) species such as Sweet Bursaria, Golden Wattle and Silver Wattle.

There should be specific conservation guidelines for the threatened Clover Glycine if survey shows this to be viable or recoverable.

The parkland provides vital open space as well as an outdoor education centre on natural heritage values. The wildflower area supports native grassland and shrubland under Candlebarks and Swamp Gums (a rare feature in the inner region). The hill-slopes above the creek in the eastern section of the park put on an attractive native grass and wildflower display in late spring, particularly the Chocolate Lily, Showy Parrot-pea, Gold-dust Wattle, Grey Tussock-grass and Kangaroo Grass. The park is a remnant natural feature in a developing urban area which has undergone rapid and large-scale destruction of native vegetation over the last two decades.

Site 53 Wombat Drive–Piper Crescent Research

- Map Reference:** 7922 383258 to 7922 382264 (east of Kirwan Avenue to south of Wombat Drive); 7922 378263 (north of Marion Way); 7922 383256 to 7922 382261 (west end of Piper Crescent to Leanne Drive). One minute lat/long grids include 37° 41' x 145° 09'.
- Location/Size:** Area west of the old Maroondah aqueduct between Piper Crescent and Wombat Drive Research. Approximately 30 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: nil. Private: formerly bushland and orchards; now becoming residential.
- Landforms:** Foothill (see PLH D). Elevation is 60–100 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 3

Vegetation: degraded/fragmented Red Stringybark herb-rich foothill forest (6.1); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Gum–Red Box box–ironbark woodland (12.3). Cleared/residential remnants of 10.3, 11.3, 14.5, 31.1

Notable features: the stand of Yellow Gum at Piper Crescent is an outlier of vegetation occurring in the Plenty Gorge. Along with Lorimer Road, this forms the eastern range limit of Yellow Gum in south-eastern Victoria. Blakely's Red Gums in the residential area between Zig Zag Road and Kirwan Avenue

FAUNAL SIGNIFICANCE: Site 53 Wombat Drive–Piper Crescent Research

Assessment: Regional—Category 2 (B, D, E)

Reference grids for the significance keys include:

53^a: 37° 41' x 145° 09'; Wombat Drive–Piper Crescent, Research

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 53^a: Swift Parrot (two birds in flowering Yellow Gums at the west end of Piper Crescent on 7 April 1992)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

Local. 53^a: 3 species in flowering Yellow Box at Wombat Drive, 500 m east of Zig Zag Road on 27 December 1991: Brown-headed Honeyeater, White-naped Honeyeater and Yellow-faced Honeyeater

f. Breeding migratory insectivores

Local. 53^a: 5 species in bushland on the south side of Wombat Drive, 500 m east of Zig Zag Road on 27 December 1991: Fan-tailed Cuckoo, Shining Bronze-Cuckoo, Rufous Whistler, Black-faced Cuckoo-shrike and Olive-backed Oriole

k. Frogs

Local. 53^a: 4 species in bushland under the transmission lines at the north end of Marion Way on 31 August 1990

l. Reptiles

Local. 53^a: 3 species including the Blotched Blue-tongued Lizard and Delicate Skink in bushland east of Kirwan Avenue on 31 August 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 53^a: 78 species

b. Native birds

Regional. 53^a: 64 species

c. Native mammals

Local. 53^a: 5 species

d. Herpetofauna

Regional. 53^a: 9 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 53^a: 4 species

c. Regionally vulnerable fauna (R2 species)

Regional. 53^a: 1 species. **Mammals:** Long-nosed Bandicoot

e. Regionally depleted fauna (R4 species)

Regional. 53^a: 3 species. **Birds:** Swift Parrot, Speckled Warbler. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 53^a: 4 species. **Birds:** Brush Bronzewing, Rainbow Lorikeet, White-winged Chough. **Reptiles:** Delicate Skink

Outlook

Substantial loss and fragmentation of habitat due to residential development has occurred since commencement of the study in 1986. The faunal significance of the site had declined by 1993 to the tenuous Regional Category 3 and is largely dependent on whether Swift Parrots continue visiting the Yellow Gums at Piper Crescent in the face of surrounding development. The significance will continue to decline.

FAUNA

Rare or Threatened Fauna

Bb 53^a: Swift Parrot at Piper Crescent Yellow Gums. Two were seen on 7 April 1992 in a Yellow Gum which had commenced flowering at the west end of Piper Crescent (Yellow Gum–Red Box box–ironbark woodland; 12.3). Fragmentation by 0.5-1 ha subdivision of the woodland in recent years has enabled domination by birds adapted to treed open-space such as the Eastern Rosella, Noisy Miner, Rainbow Lorikeet and Red Wattlebird. The build-up in numbers of these competitive birds has reduced the suitability of the area for Swift Parrots. They still possibly occasionally visit.

Other Significant Fauna

Birds

53^a: Decline of the bushland birds. The Brush Bronzewing, Fan-tailed Cuckoo, Scarlet Robin and White-eared Honeyeater were seen on 31 August 1989 in the damp gully and dense scrub under the transmission lines at the north end of Marion Way. The habitat was Swamp Gum gully woodland (10.3) and Red Stringybark herb-rich foothill forest (6.1). The Buff-rumped Thornbill and Speckled Warbler were seen in Red Box–Red Stringybark box–stringybark woodland (11.1) at the east end of Kirwan Avenue on 31 August 1990.

The Shining Bronze-Cuckoo, White-throated Treecreeper, White-naped Honeyeater, Olive-backed Oriole and White-winged Chough were each recorded breeding in Red Stringybark herb-rich foothill forest (6.1) on the south side of Wombat Drive, 500 m east of Zig Zag Road on 27 December 1991. At the present rate of habitat loss and degradation due to residential development, populations of each of the above species are unlikely to survive

in the site beyond the year 2000. Several other species were eliminated during the 1980s (e.g. Spotted Quail-thrush, Rufous Fantail, Bassian Thrush and White-throated Nightjar).

Mammals

Ec 53^a: Long-nosed Bandicoot. One was seen in Swamp Gum gully woodland (10.3) on the south side of Wombat Drive, 500 m east of Zig Zag Road in 1990 (George Paras pers. comm.). This was at the time the nearest remaining population to the centre of Eltham. While still undeveloped, adjacent subdivision and associated disturbance had degraded the bushland. The bandicoot would now be locally extinct due to encroaching residential subdivision, fragmentation of external habitat links, habitat degradation and predation from domestic cats.

MANAGEMENT:

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective habitat links remain. There are fragmented avifauna links across residential areas to the Eltham North site and Kalbar Road site.</p>	
<p>Housing and box-stringybark woodland habitat loss, fragmentation and thinning. Habitat link severance accompanies encroaching housing development. High density residential development now abuts the site from the west and south. Habitat degradation and fragmentation has been extreme. The 0.5–2 ha blocks contain little natural habitat as the understorey shrubs are removed, logs and sticks are picked up and the grassland is converted into sweeping lawns. In these areas, the houses are bigger and the parklands fewer. Blocks have the aesthetics of town houses. They may be more detrimental to fauna than higher density subdivision, as more bushland is swallowed up to house fewer people. This puts development pressure on outlying areas.</p> <p>The area was once important for reptiles but now few, apart from the Garden Skink, remain. Similarly, bushland birds which were common in the 1980s such as Common Bronzewings and White-winged Choughs have become scarce and replaced by Spotted Turtle-doves, Common Blackbirds and Common Mynas. The long-term viability of most of the bushland species is poor.</p>	<p>Reserve bushblocks with significant fauna/habitat from subdivision. Much of the bushland between Eltham and Research has been eliminated since the mid-1980s and little that remains is likely to be reserved. Without incorporation of this bushland as open space the current faunal and habitat values will diminish.</p> <p>Retain habitat links (e.g. creekways to the Diamond Creek).</p> <p>Native bushland understorey retention/enhancement in urban areas.</p>

Other Issues

Little reservation of bushland habitat; poor long-term survival of fauna. Despite being recently important for native flora and fauna, new residential areas in the long term may have lower conservation values than older development nearer town. Unless there is an immediate turn-around in the present community attitude, the significant bushland fauna habitat will be eliminated.

Community apathy towards conservation of local 'bushblocks'. There is a great deal of community apathy toward local nature conservation in developing areas and as a consequence bushland remnants are being degraded.

Rubbish dumping, firewood removal, vehicles, weed and vermin invasion. Vacant bush is stripped of firewood, dumped with rubbish, invaded by weeds and vermin and overrun with people, trail bikes, and roaming cats and dogs. Much of the rubbish is tree and shrub prunings from adjacent houses. Areas adjacent to housing estates become dumping grounds for building rubble and are scarred with small piles of concrete where cement trucks are washed out.

Development of a strategy for conservation of remnant native vegetation in urban areas.

Landowner education on conservation practices and covenants.

High rates of public use of remnant bushland. This indicates a necessity for retained bushland as well as open space.

Planning Recommendations

Provision of public open space. The conservation of flora and fauna requires that a minimum of 5% of the land zoned Residential within the management unit should be incorporated as public open space and managed for nature conservation as well as public utility. This must contain the most significant areas of bushland (determined as the sites of significance). These areas should be protected from degradation during residential development of adjacent land.

YARRA LOWLAND HILLS (YLH)

Farmland, bushland and urban catchments of the middle Yarra River between Nillumbik South and Yarra Glen and the lower reaches of its tributaries including the Watsons, Mullum Mullum and Brushy creeks.

Land-use

Past land-use: pastoral, townships, orchards, firewood and mining. Present land-use: the Warrandyte State Park, Yarra Valley Park (upstream of Diamond Creek), bushblock and farmlet settlement, urban/township and outdoor education and recreation (e.g. park information centres and trails) in the west and the Warrandyte State Park, bushblock and farmlet settlement, water supply, environmental living, pastoral and outdoor education and recreation (e.g. Clifford Park activity centre, horse riding and Yarra kayaking and fishing) in the east.

Native vegetation cover

Fragmented in the west, extensive to the north of the Yarra upstream of Watsons Creek, and highly fragmented south of the Yarra east of Brushy Creek.

Key biological features

Barking Owl, Powerful Owl, Swift Parrot, Azure Kingfisher, Regent Honeyeater, Little Friarbird, Platypus, Brush-tailed Phascogale, Common Bent-wing Bat, Large-footed Myotis, Lesueur's Frog, Broad-finned Galaxias, Freshwater Blackfish and Large Ant-blue butterfly.

The most significant habitats are valley, riparian and dry sclerophyll (particularly Red Ironbark) forests.

Of particular note are the faunal rarity, abundance and diversity, habitat rarity and abundance, a lowland river ecological reference area, the box woodland, foothills streamway and Swamp Paperbark critical conservation areas, and the strategic habitat links between the upland hills and lowland alluvial plains (primarily the Yarra River and Watsons Creek).

Key areas/physical features for biota

The Yarra Valley Park including Pettys Wetland and Morrisons/Paddles, Yarra River, Yering and Warrandyte Gorges, Watsons Creek, Warrandyte SP, Professors Hill Flora Reserve, Kalbar Road Reserve, Pound Bend Tunnel, Round the Bend Cooperative, Gravel Quarries Backswamp and the Maroondah Aqueduct.

11 sites of significance: 5 state and 6 regional for fauna and 3 very high, 5 high and 3 medium for habitat.

YLH A NORTH WARRANDYTE–RESEARCH

This management unit consists of three sites of regional faunal significance (sites 54, 55 and 56) and surrounding land that forms (restricted) habitat links.

Map Reference: 7922 416213 to 7922 395281 (south to north) 7922 380266 to 7922 466264 (west to east).

Location/Size: Approximately 1700 ha.

Municipality: Shire of Nillumbik.

Description: The unit is divided into two sections by Research township and cleared land stretching from Research to Kangaroo Ground. Residential development has fragmented and degraded sites in the western section. The Pretty Hill and Stony Creek sites contain larger parcels of bushland. The unit contains a mosaic of residential areas, farmlets, orchards and bushblocks. Pretty Hill contains the Shire of Nillumbik tip.

Physical Features

The management unit forms part of the lowland hills of the Eastern Uplands. It is made up of undulating and heavily folded hills and valleys, becoming steeper in the east at Kangaroo Ground Hill, the most prominent point for some distance. There is a central ridgeline encompassing the Research–Kangaroo Ground–St Andrews Road which divides the headwaters and upper reaches of several creeks which flow west to the Diamond Creek and south to the Yarra River. Pretty Hill Creek/Dry Creek drains most of the northern section of the unit west to Diamond Creek from the Kangaroo Ground ridge. Stony Creek, Pigeon Bank Gully and Laughing Waters Creek drain south to the Yarra River.

Landforms

Foothill: hill-crests, hill-slopes, gullies, valleys, creeks, aqueduct and dams. Volcanic plain: volcanic cone (Kangaroo Ground Hill), volcanic cappings. Alluvial plain: sand-plains. Elevation is 30–230 m (Kangaroo Ground Hill).

Hydrology

Stony Creek and Pigeon Bank Gully were probably perennial before settlement land clearing. Stony Creek is again perennial as it is fed by overflow from the Winneke Pipeline at a booster pumping station situated along the old Maroondah Aqueduct on the east side of Bells Hill. Stony Creek contains fast moving water which has cut exposed rocky reefs and has the appearance of a mountain stream. Pretty Hill Creek contains shallow, static pools and dry cobble and gravel riffles with sandy banks. The creek channels are deeply scoured and the banks are undercut and have undergone severe slumping and erosion.

Rainfall: 670–720 mm.

Site 54 Pretty Hill–Eltham College

- Map Reference:** 7922 397268 to 7922 415258 (tributary of Dry Creek coming off Bells Hill/Eltham College); 7922 407262 (Eltham College bushland); 7922 393273 to 7922 423273 (Pretty Hill Creek from Orme Street to upstream of Kangaroo Ground tip). One minute lat/long grids include 37° 41' x 145° 11' to 145° 12' and 37° 42' x 145° 11'.
- Location/Size:** Northern tributary catchments of Dry Creek between Reynolds Road and the Kangaroo Ground–St Andrews Road (including Pretty Hill at Kangaroo Ground) and the southern tributary catchment in the Eltham College area. Approximately 350 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Melbourne Water (pipeline easement south of Eltham College; the sections of the Maroondah Aqueduct north-west of Eltham College decommissioned in the early 1980s were transferred from Melbourne Water to the Crown and managed by Shire of Nillumbik—they are now linear reservations for bicycle and walking paths and passive recreation). Council reserves (block to the north of the Eltham College bushland and Shire of Nillumbik tip and bushland at Pretty Hill Reserve.) Private: school grounds (Eltham College bushland), bushblocks and farmlets (e.g. poultry). There are two protea farms along Reynolds Road.
- Landforms:** Foothill, volcanic plain and alluvial plain (see YLH A). Elevation is 50–190 m.

Natural Heritage Values

Landscape. Pretty Hill Reserve at Kangaroo Ground supports relatively extensive and intact lowland foothill landscapes and vegetation. Areas elsewhere within the management unit are fragmented or degraded. These include the Eltham College bushland which was partially cleared in late 1992 and the Kalbar Road Reserve at Research, adjoining bushland which is proposed for development.

Scientific and Educational Values

Known or suspected palaeontological or Aboriginal archaeological site—silcrete quarries. Silcrete stone artefacts crafted by Aborigines occurring in the hills of the Diamond Creek system have likely been transported from the Pretty Hill Tertiary basalt/river alluvium outcrops.

Rehabilitation and management. Pretty Hill Reserve and nature reserve at Eltham College. Conservation works including woody weed control along the Pretty Hill Creek north branch by the Shire of Nillumbik has enabled a marked recovery in the vegetation quality of the gully woodland (10.3).

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference stands: nil

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Swamp Gum gully woodland (10.3); Red Box–Red Stringybark (hill-crest) box–stringybark woodland (11.1); Red Stringybark (exposed valley) box–stringybark woodland (11.3)

Partially intact or small stands: Narrow-leaf Peppermint (sheltered escarpment) herb-rich foothill forest (6.2); Manna Gum gully woodland (10.1); Yellow Box–Red Stringybark (hill-crest) box–stringybark woodland (11.2); Yellow Box–Candlebark valley forest (31.1; creek draining bushland between Lorimer Road and Reynolds Road)

Rare species: Slender Tick-trefoil

Notable features: Swamp Gum gully woodland (10.3) and Red Stringybark box–stringybark woodland (11.3) at Pretty Hill; few intact/extensive stands are represented on public land in NEM; disjunct plains gully woodland flora of Pretty Hill Creek west branch (e.g. Sea Celery); diverse Red Box–Red Stringybark box–stringybark woodland (11.1); orchid flora of Pretty Hill Reserve

FAUNAL SIGNIFICANCE: Site 54 Pretty Hill–Eltham College

Assessment: Regional—Category 1 (C, D, E, F)

54^a: 37° 41' x 145° 11'; Pretty Hill, Kangaroo Ground

54^b: 37° 42' x 145° 11'; Eltham College, Research

A. Cited Zoological Significance

Regional.

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Unranked. 54^b: Common Bent-wing Bat formerly in the No. 1 Maroondah Aqueduct tunnel at Bells Hill

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 54^b: 8 species including the White-browed Woodswallow, White-winged Triller, Rufous Songlark, Satin Flycatcher and White-throated Gerygone at Eltham College on 28 October 1991

Regional. 54^a: 8 species including the Sacred Kingfisher and Satin Flycatcher between Lorimer and Reynolds Road on 1 November 1989; 7 species including the Leaden Flycatcher at Pretty Hill Reserve on 19 October 1991

h. Bats

Regional. 54^a: 5 species trapped on 11 March 1992

i. Arboreal mammals

Unranked. 54^a: 3 species on 1 November 1989

j. Ground mammals

Unranked. 54^a: 3 species on 1 November 1989

k. Frogs

Regional. 54^a: 8 species including the Victorian Smooth Froglet, Striped Marsh Frog and Growling Grass Frog from a 2-hour herpetofauna census at Pretty Hill Reserve on 25 October 1995; 6 species including the Victorian Smooth Froglet and Bibron's Toadlet between Lorimer Road and Reynolds Road on 10 March 1992

l. Reptiles

Regional. 54^a: 9 species including Common Long-necked Tortoise, Tree Dragon, Southern Water Skink, Blotched Blue-tongued Lizard, Delicate Skink, Weasel Skink, Lowland Copperhead and Eastern Brown Snake from a 2-hour herpetofauna census at Pretty Hill Reserve on 25 October 1995; 6 species including Tree Dragon, White's Skink, Eastern Three-lined Skink and Red-bellied Black Snake between Lorimer Road and Reynolds Road on 10 March 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 54^a: 153 species. **54^b**: 100 species

b. Native birds

Regional. 54^a: 118 species. **54^b**: 76 species

c. Native mammals

Regional. 54^a: 13 species. **54^b**: 10 species

d. Herpetofauna

Regional. 54^a: 22 species. **54^b**: 14 species

f. Butterflies

Regional. 54^a: 28 species. **54^b**: 23 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM Critical fauna (R1-R4 species)

Regional. 54^a: 16 species

c. Regionally vulnerable fauna (R2 species)

Regional. 54^a: 3 species. **Birds**: Black-eared Cuckoo, Red-capped Robin, White-throated Gerygone

Regional. 54^b: 1 species. **Birds**: White-throated Gerygone

d. Regionally rare fauna (R3 species)

Regional. 54^a: 3 species. **Birds**: Collared Sparrowhawk, Little Corella, Spotted Quail-thrush

Regional. 54^b: 1 species. **Birds**: White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 54^a: 10 species. **Birds**: Whistling Kite, Peregrine Falcon, Rainbow Bee-eater, Leaden Flycatcher, Speckled Warbler. **Reptiles**: White's Skink, Red-bellied Black Snake. **Frogs**: Bibron's Toadlet. **Butterflies**: Spotted Brown, Blue Jewel

Regional. 54^b: 4 species. **Birds**: Speckled Warbler, White-winged Triller, Rufous Songlark. **Frogs**: Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 54^a: 16 species. **Birds**: Brush Bronzewing, Great Egret, Cattle Egret, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, White-winged Chough. **Reptiles**: Common Long-necked Tortoise, Delicate Skink. **Frogs**: Striped Marsh Frog. **Butterflies**: Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Meadow Argus, Dark Purple Azure, Chequered Blue

Local. 54^b: 6 species. **Birds**: Painted Button-quail, Barn Owl, White-winged Chough. **Reptiles**: Delicate Skink. **Butterflies**: Phigalia Skipper, Dark Purple Azure

g. Nesting birds of prey/parrots

Regional. 54^a: Rainbow Lorikeet: several pairs in hollows of Yellow Box in valleys above Pretty Hill Creek north branch on 25 October 1995

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

Regional. 54^a: Pretty Hill Creek south branch wetland; 450 Australian White and Straw-necked Ibis, May 1995

Outlook

The faunal significance is declining due to urban expansion and habitat loss. Despite an apparent lack of a threatened species and failing on density criteria, the Pretty Hill section achieves Category 1 conservation status as it still supports broad species diversity and representativeness components.

FAUNA

Rare or Threatened Fauna

Bc 54^b: Former Common Bent-wing Bat colonies in the Maroondah aqueduct tunnels. The Maroondah aqueduct supplied water for almost 90 years to Melbourne's northern suburbs until a pipeline from Winneke Treatment Plant to Reservoir was commissioned. A large colony (possibly a thousand) Common Bent-wing Bats (and probably small numbers of Large-footed Myotis) was present in the 1970s in the long, native rock tunnel (No. 1 tunnel) under 'Bells Hill' south of Eltham College (Craig Smith pers. comm.). In the early 1980s the Stony Creek-Reservoir high pressure pipeline was built in the tunnel, permanently closing-off access to bats.

The section of aqueduct below No. 1 tunnel, towards Research was decommissioned at this time and became accessible to humans. Small numbers of bats, possibly the Large-footed Myotis, had inhabited the brick and

cement-rendered tunnel under Main Road (Craig Smith pers. comm.). The tunnel under Main Road is dark in its middle section but no cave-bats or signs of cave-bat usage were detected in the tunnel during the day of 31 March 1992. None emerged from the entrance in the evening. The tunnel contains shallow water and a timber walkway was installed by the CFA (Joy Pagon pers. comm.). The tunnel was boarded up at each end and used briefly as a smoke chamber for simulated rescue exercises.

Other Significant Fauna

Birds

Cf **54^b: Breeding migratory insectivorous birds at Eltham College.** These species are spring–summer migrants from northern Australia. Despite urban encroachment and fragmentation this avifauna was relatively diverse (eight nesting species) when surveyed on 28 October 1991. Regionally significant species included the White-winged Triller, Rufous Songlark, White-browed Woodswallow and White-throated Gerygone. Other species included the Sacred Kingfisher and Satin Flycatcher. Each species is rare or absent closer to Melbourne and each has become uncommon in the lowland hills. They have declined in NEM largely due to forest fragmentation and may shortly cease visiting the urban area (if they have not already) because of bushland clearing for residential and recreational development.

The Rufous Songlark and White-browed Woodswallow were seen near Main Road in Red Box–Red Stringybark box–stringybark woodland (11.1). The songlarks had built a cup-nest of grass on a dead upper-canopy branch-fork. The male was performing its musical territorial and courtship song-flight from the tree-tops. Rufous Songlarks spend much time close to the ground where they feed on invertebrates and seeds. The native grassland (Kangaroo Grass and Weeping Grass) and copses of Black Wattles and Hedge Wattles under the Red Box provided important feeding habitat for the songlarks. The White-winged Triller was nesting in an adjacent tree to the songlarks. The behaviour of the White-browed Woodswallows suggested that they were about to commence nesting in a hollow of an old Red Box.

A pair of White-throated Gerygone was seen in the gully in the central section (now immediately adjacent to the ovals) in Yellow Box–Candlebark valley forest (31.1). The stand contained native tussock grassland and shrub thickets of Sweet Bursaria, Black Wattle and Burgan. The flute-like early breeding season song of the male was heard in the canopy of the Yellow Box. The Speckled Warbler was recorded in this area in October 1991.

Db **54^a: Avifauna of Pretty Hill Reserve and a tributary of Dry Creek between Lorimer and Reynolds Road.** Bird surveys conducted in the catchments of Pretty Hill Creek (Pretty Hill Reserve; area A) and a creek draining bushland between Lorimer Road and Reynolds Road (area B) recorded 118 native species. This forms one of the most diverse assemblages recorded in the Yarra Lowland Hills and supports representative avifauna of the alluvial plains and foothills.

Dominant habitat types include Red Stringybark and Narrow-leaf Peppermint herb-rich foothill forest (6.1/6.2) on the sheltered hill-slopes and escarpments, Manna Gum and Swamp Gum gully woodland (10.1/10.3) along creeks, gullies and sheltered valleys and box–stringybark woodland (Red Box–Red Stringybark and Red Stringybark (11.1/11.3) on hill-crests and exposed hill-slopes and valleys. An extensive stand of Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7) occurs at the Pretty Hill Reserve wetland on Pretty Hill Creek south branch.

Resident or breeding migrant plains species include:

- Brown Goshawk: 6.1/A on 20.6.95 and 10.1/A on 9.11.89
- Rainbow Lorikeet: 14.6/A on 25.10.95; several breeding pair in hollows of Yellow Box in valleys above Pretty Hill Creek north branch
- Crimson Rosella: 14.6/A on 19.10.91
- Red-rumped Parrot: 14.6/A on 19.10.91
- Sacred Kingfisher: 10.1/B on 9.11.89
- Rainbow Bee-eater: 10.1/B on 10.3.92
- Black-eared Cuckoo: 14.6/B on 10.3.92
- Jacky Winter: 14.6/A on 19.10.91
- Red-capped Robin: 14.6/B on 10.3.92

Non-breeding plains visitors include:

- Little Lorikeet: 10.1/B on 10.3.92 and 12.2/A on 19.5.95; flowering Red Ironbark–Yellow Gum box–ironbark woodland along Lorimer Road
- Little Corella: 6.2/A on 20.6.95
- Long-billed Corella: 10.1/B on 31.8.90

Resident or breeding migrant foothill species include:

- Collared Sparrowhawk: 10.1 and 25.7/A on 25.10.95
- Rufous Fantail: 10.1/B on 9.11.89
- Speckled Warbler: 11.1/B on 9.11.89
- Satin Flycatcher: 6.1/B on 9.11.89
- Leaden Flycatcher: 10.2/A on 19.10.91
- White-throated Gerygone: 14.6/B on 10.3.92
- Olive-backed Oriole: 10.3/B on 9.11.89 and 11.3/A on 19.10.91
- White-winged Chough: 10.3/B on 9.11.89 and 11.3/A on 19.10.91

Non-breeding upland visitors include:

- Brush Bronzewing: 14.6/B on 10.3.92
- Whistling Kite: 10.1/A and over open paddocks on 19.5.95
- Wedge-tailed Eagle: 14.6/B and over open paddocks on 10.3.92
- Yellow-tailed Black-Cockatoo: 6.1/A on 19.5.95
- Gang-gang Cockatoo: 10.1/B on 31.8.90; 10.2/A on 19.5.95
- Spotted Quail-thrush: 11.3/B on 10.3.92
- White-eared Honeyeater: 6.1, 10.1 and 10.2/B on 10.3.92
- Crescent Honeyeater: 10.3/B on 31.8.90; flowering Drooping Mistletoe.

Ec **54^a: Black-eared Cuckoo, Red-capped Robin and White-throated Gerygone.** Each species was seen on 10 March 1992 in Yellow Box–Candlebark valley forest (31.1) in the valley of a creek draining bushland between Lorimer Road and Reynolds Road. The habitat contained dense tall shrub and field (grass tussock) strata. The Red-capped Robin was associated with a copse of Black Wattles. It was feeding on small insects while hopping along the ground or making short aerial sallies from vantages on dead overhanging branches. The White-throated Gerygone and Black-eared Cuckoo are spring–summer migrants. Both were juvenile birds which were likely to have been reared locally. Adult White-throated Gerygones usually return north by late February, once the young become independent. The young depart a month later. The Black-eared Cuckoo feeds and breeds in the realm of small shrub layer insectivores such as the Weebill, Buff-rumped Thornbill and Yellow Thornbill, which are the prospective parents of the young.

Ee **54^a: Rainbow Bee-eater, Speckled Warbler and Leaden Flycatcher.** Several adult and juvenile Rainbow Bee-eaters were recorded along a tributary of Dry Creek draining bushland between Lorimer Road and Reynolds Road on 10 March 1992. Breeding burrows were located along the banks of the creek in Manna Gum gully woodland (10.1). Creek bank degradation is the likely major cause of the bee-eater's decline.

The Speckled Warbler was breeding on a nearby exposed hill-slope in Red Box–Red Stringybark box–stringybark woodland (11.1) on 1 November 1989. The domed nest constructed of grass and bark was placed at the base of a grass tussock. It is a sedentary species and lives in a loose communal association during autumn–winter with Buff-rumped and Yellow-rumped Thornbills and Weebills. The warbler inhabits thickets of Black or Golden Wattles, Burgan or Sweet Bursarias with a tussock understorey of Kangaroo Grass, Grey Tussock-grass and Silvertop Wallaby-grass. They are uncommon in NEM.

The Leaden Flycatcher was breeding in Red Stringybark box–stringybark woodland (11.3) near Pretty Hill Creek north branch in Pretty Hill Reserve on 19 October 1991. It had a cup-shaped nest on an open, horizontal

branch in the mid-level of a Yellow Box. Stand fragmentation and elimination of tall shrubs by clearing and livestock grazing has depleted the Leaden Flycatcher and Speckled Warbler.

54^b: Owls using the large Red Box at Eltham College for homesites. The Southern Boobook and Australian Owlet-nightjar were heard calling from the bushland opposite the Ecacentre and the Barn Owl was seen during an evening survey along Main Road on 31 March 1992. The Tawny Frogmouth had been observed at a day roost in the Eltham College bushland south of Main Road on 7 October 1991.

54^a: Waterbirds of the Pretty Hill Reserve south branch wetland and tip quarryhole wetland. Twenty-two species were recorded during surveys in 1995. The Pretty Hill Creek south branch wetland is referred to as area A and the quarryhole wetland to the west of the tip is referred to as area B. An extensive stand of Common Reed–Cumbungi (emergent herbfield) seasonal wetland (25.7) fringes the south branch wetland. The waterbody largely contains deep open water supporting minimal submerged herbfield. If this develops several additional species of waterfowl may visit the wetland. The introduction of native fish would attract species such as the Australian Pelican and more permanent populations of cormorants. The large trees in Narrow-leaf Peppermint herb-rich foothill forest (6.2) and Yellow Box–Candlebark valley forest (31.1) on the sheltered escarpment and valley adjacent to the Pretty Hill Creek south branch wetland form an important night roost for waterbirds (e.g. 450 Australian White and Straw-necked Ibis during May 1995). The rocks and islands in the wetland to the west of the tip form a day roost (area B). Revegetation works to improve waterbird habitat are suggested for both wetlands.

Significant or breeding species include Dusky Moorhen (breeding/A), Eurasian Coot (breeding/A), Australasian Grebe (breeding/A), Hoary-headed Grebe (A), Little Pied Cormorant (A/B), Great Cormorant (A), Little Black Cormorant (A/B), Silver Gull (B), Black-fronted Dotterel (breeding/B), Australian White Ibis (A/B), Straw-necked Ibis (A/B), Yellow-billed Spoonbill (B), Great Egret (A), Cattle Egret (A), Chestnut Teal (A) and Grey Teal (A).

54^b: Decline of ground-dwelling birds. The bushland to the north of Eltham College extended more continuously along Cassells Road in the 1970s and supported species which are now almost certainly locally extinct (e.g. White-throated Nightjar; Ken Rogers pers. comm.). Local populations of foxes would appear to be high on the basis of scats and live animals seen. The most significant ground-dwelling bird recorded at Eltham College was the Painted Button-quail, on 31 March 1992.

54^a: Australian Ravens at the Pretty Hill tip. Ten or more breeding pair occur at the tip, which is a high density for the lowlands. Their drawn out calls are a familiar sound over the valleys at Pretty Hill. Several other scavenger species including Silver Gulls and Australian White Ibis are also attracted to the tip.

Mammals

54^b: The large Red Box at Eltham College support homesites for tree-hollow mammals. Survey of the Red Box–Red Stringybark box–stringybark woodland (11.1) to the north of Main Road at Eltham College was restricted to brief day visits on 7 and 28 October 1991, subsequent visits in association with staff and students during orchid rescue operations in winter 1992 and a dusk walk along Main Road in front of the Ecacentre on 31 March 1992. The mature trees present provided potential roosting habitat for tree-hollow bats. At least eight species might be expected to occur. Four species (White-striped Freetail Bat, Lesser Long-eared Bat, Gould's Wattled Bat and Little Forest Bat) were observed at dusk on 31 March 1992 hawking insects around the lights in front of the Ecacentre. A potential area to trap bats would be a dam near the fenceline between the proposed ovals and the nature reserve. A Sugar Glider was also recorded on 31 March 1992 emerging from a hollow in a Red Box near Main Road opposite the Ecacentre.

Reptiles and frogs

Dd **54^a: Pretty Hill Creek and a tributary of Dry Creek between Lorimer and Reynolds Road.** Twenty-two species were recorded from herpetofauna surveys conducted in the catchments of Pretty Hill Creek (Pretty Hill Reserve; area A) and a creek draining bushland between Lorimer Road and Reynolds Road (area B). This represents the most diverse overlap of plains and foothills herpetofauna in the Yarra Lowland Hills biophysical zone. Nine reptile and eight frog species were recorded from a 2-hour herpetofauna census at Pretty Hill Reserve on 25 October 1995. The dominant habitats are listed under birds (*Dd*). Significant species include:

- Common Long-necked Tortoise: south branch wetland in 25.7/A on 25.10.95
- Tree Dragon: 1 in 11.1/A on 25.10.95 and 1 in 11.1/B on 10.3.92
- Southern Water Skink: 2 in 10.1/A on 25.10.95 (south branch)
- White's Skink: 1 under log in 14.6/B on 10.3.92
- Blotched Blue-tongued Lizard: 10.3/A on 25.10.95; rarer than CB-t Lizard
- Delicate Skink: several in 11.3/A on 19.10.91 and 14.6/A on 25.10.95
- Weasel Skink: 1 in 6.2/A on 19.10.91 and 25.10.95
- Eastern Three-lined Skink: 1 in grassland in 14.6/B on 10 March 1992
- Red-bellied Black Snake: 1 in 10.1/B on 10.3.92
- Lowland Copperhead: 1 in 10.3/A on 25.10.95
- Eastern Brown Snake: 1 in 11.3/A on 25.10.95
- Victorian Smooth Froglet: several in 10.1/A on 10.3.92 and 10.3/A on 25.10.95
- Bibron's Toadlet: 2 in 14.6/B on 10 March 1992
- Striped Marsh Frog: several in 25.7/A on 25.10.95

54^b: Habitat refugia in the Eltham College bushland. Six reptile species were recorded on 28 October 1991 in Red Stringybark herb-rich foothill forest (6.1) and Red Box–Red Stringybark box–stringybark woodland (11.1) on the north side of Main Road. These included the Blotched Blue-tongued Lizard, Delicate Skink, Weasel Skink, Lowland Copperhead and Eastern Brown Snake (freshly sloughed skin). Snakes have declined with encroaching residential development and land clearing and their long-term survival is considered unlikely. A road-kill Common Blue-tongued Lizard was seen near the college on 27 March 1992. Six species of frogs were also recorded, the most significant being the Bibron's Toadlet, which was heard calling in remnant Red Stringybark herb-rich foothill forest (6.1) at the Main Road aqueduct bridge on 27 March 1993.

Butterflies

54^a: Pretty Hill Reserve. Twenty-eight species were recorded from four visits (14 November and 19 December 1993 and 18 January and 5 March 1994). The diversity compares favourably with the 20 species recorded in a recent butterfly survey of similar habitat along Mullum Mullum Creek (Yugovic *et al.* 1990). Two regionally depleted species were recorded. The Spotted Brown was observed along the Pretty Hill north branch under Swamp Gum gully woodland (10.3) on 5 March 1994. The local food-plant of the larvae is Slender Tussock-grass. A female Blue Jewel was observed laying eggs in a senescent Black Wattle (Yellow Box–Candlebark grassy woodland; 14.6) in a tributary gully of the Pretty Hill north branch on 19 December 1993. Pretty Hill Reserve is a fine area for Satyrinids (browns and xenicas).

Regionally restricted species included the Doubleday's Skipper (19 December), Spotted Skipper (14 November, on the sheltered hill-slopes between Lorimer Road and Pretty Hill Creek north branch), Phigalia Skipper (14 November), Dark Purple Azure (18 January) and Chequered Blue (19 December, female inspecting Nodding Saltbush, presumably ovipositing as the species is a larval food-plant). Locally significant species include the Cyril's Brown (upland species). This was seen on the sheltered hill-slopes between the north branch and Lorimer Road on 14 November.

54^b: Eltham College. Twenty species have been recorded (Fabian Douglas pers. comm.). Regionally restricted species include the Phigalia Skipper and Dark Purple Azure. Locally significant species include the Dispar Skipper, Bright Shield Skipper, Wood White, Klug's Xenica, Shouldered Brown, Olane Azure, Common Imperial Blue, Common Dusky Blue and Double-spotted Line Blue.

An additional nine butterfly species including the rare Fiery Jewel and the Rare White-spot Skipper and regionally significant Spotted Brown, Small Copper and Fringed Blue were recorded in the 1960s and 1970s from the Eltham College bushland (Fabian Douglas pers. comm.). Only two sightings of the Fiery Jewel and Rare White-spot Skipper have been made in NEM since 1986. The other four species recorded in the 1960s and 1970s included the Phigalioides Skipper, Symmomus Skipper, Cyril's Brown and Meadow Argus.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Partially intact habitat link west via Dry Creek to the Diamond Creek site. Severed links north to the Hurstbridge–Kangaroo Ground Red Ironbarks site and south to the Kalbar Road site.</p>	
<p>Prior habitat loss and fragmentation and current expansion of residential/recreational development at Research. No relatively extensive and intact bushland remains around Research because of fragmentation from farming and urban development. This process continues (e.g. clearing of a section of the Eltham College bushland in late 1992). Only one partially effective habitat link remains, extending north-west along the main tributary of Dry Creek to the Diamond Creek site. The lack of habitat links to these remnant areas of bushland makes it uncertain whether they are internally large or intact enough or adequately buffered to maintain viable populations of the remaining species assemblages.</p> <p>Many forest-dependent faunal species have been replaced by species adapted to urban or farmland environments in the remnant areas of bushland. Ground fauna populations have been severely depleted. Weeds such as Flax-leaf Broom and Panic Veldt Grass have invaded the remnant bushland areas. Some of the stands (e.g. Eltham College bushland) still support significant avifauna populations. The old Red Box and Yellow Box trees support hollow-nesting fauna. The effects of habitat fragmentation and weed invasion caused by the land clearing and ongoing disturbances will become primary issues in areas under management such as the Eltham College nature reserve. Extensive management input is now required to maintain populations of native species and control the weeds.</p>	<p>Strengthen habitat links. The site is a key part of the inner green wedge of the Shire of Nillumbik. It acts as a doorway for the movement of animals and a buffer zone between the urban area and bushland. It is the main link that brings Eastern Grey Kangaroos, Wedge-tailed Eagles and a host of other species to outer urban parts of Eltham North and Diamond Creek. Urban development will cause further habitat fragmentation and degradation and reduce management efficiency of remnant conservation areas such as the Eltham College nature reserve. Habitat links both interior and exterior to the site need to be strengthened for many forest species to survive in the site.</p> <p>Retain and protect remaining stands of bushland. Planning needs to consider the retention of all stands of bushland in the site or else outer, more important bushland areas between Kangaroo Ground and Pantom Hill may ultimately fall to the advance of urban development. To enact the ‘Green Wedge’ philosophy these areas will need to be placed under stronger conservation zoning. Important sites on the edge of urban development need to be given a high priority for conservation as a primary land-use.</p> <p>Restore Pretty Hill Reserve. The valley of Pretty Hill is biologically significant and should be rehabilitated. The bushland and surrounding open space farmland supports a diverse fauna (over 150 native species). There is little public land in this corner of the Shire of Nillumbik and none of any extent and biological value apart from this. Management to restore the conservation values of the valley should be a major land-use priority.</p>
Other Issues	

<p>Spread of weeds and vermin; rubbish dumping along the aqueduct. Weeds are spreading in the old Maroondah aqueduct and along the creek and road verge on the Eltham College land. House blocks backing onto the aqueduct contain few native plant species and virtually no indigenous species. Rubbish is dumped in the aqueduct and Black Rats inhabit these areas. They live in the piles of rubbish at the entrances and under the timber walkway in the Main Road tunnel. The rats and frequent visitation from humans prevent bats from roosting in the tunnel. Complaints about mosquitos, rats and the rubbish may influence the council to fill in the aqueduct.</p>	<p>Weed control and revegetation along aqueduct verges. Any filled-in sections of the aqueduct should be revegetated. Native trees and shrubs should be planted along the strips beside the aqueduct and in any filled-in sections. Ground layer weeds along the aqueduct including Cocksfoot, Yorkshire Fog-grass, Couch and Paspalum should be controlled as these are swamping the native grass. Sweet Pittosporum and Blackberry should also be removed. Native low shrub species such as the Clustered Everlasting and Gold-dust Wattle should be planted. Overstorey plants such as Lightwood, Black Wattle, Golden Wattle, Yellow Box and Red Box, which are all sparsely present, should also be planted. Rubbish should be removed from the aqueduct. Landowners should be discouraged from dumping colonising garden refuse such as English Ivy.</p>
<p>Poor conservation management of most bushland remnants in the site. There is no conservation management of most areas of native bushland remaining in the site and the biological values are under threat. The major issues are spreading weeds, and large populations of foxes and rabbits. Feral cats inhabit the Pretty Hill tip and probably other areas. The speed and volume of traffic along Main Road is a significant mortality factor for wildlife, which has reduced the effectiveness of habitat links for ground fauna between the northern and southern sections of the management unit.</p>	<p>Conservation covenants and land protection group. Fauna and faunal habitat values may be best enhanced through conservation covenants and the formation of a community conservation and land protection group. Both play an important role in land protection.</p> <p>Implementation of Native Vegetation Clearance Controls on private land.</p>

Eltham College nature reserve

Suggestions for management. The area has not been visited for several years and it is unknown whether the habitat condition has declined since the oval development. Appropriate conservation assessment of the area first requires an extensive flora and fauna survey to determine what species are present and what their management requirements are. The following suggestions may assist in management.

- **Eltham College Nature Reserve management plan.** This should be prepared along scientific guidelines which assess the management of significant animal and plant populations and fragmented bushland ecosystems. A land protection program will be vital for long-term viability of flora and fauna populations in the bushland.
- **Reduce disturbance impact.** Habitat fragmentation and disturbance from earthworks and runoff caused by the oval development will have an impact on the nature reserve. It is important to undertake extensive rehabilitation operations of the buffer areas. Runoff from the ovals should be diverted through a settling/filtration pond. Planting local waterplants would improve the pond for frogs and other aquatic life and the potential for wetland studies. This will reduce the level of nutrient output into the creek. Minimal watering and fertiliser application on the ovals would be the ideal from a conservation viewpoint. Significant large trees have been retained around the ovals. Landscaping should incorporate indigenous shrub and herb species. Weeds, particularly alien grasses such as Large Quaking-grass and Sweet Vernal-grass and shrubs such as Montpellier Broom and Flax-leaf Broom should be controlled.

- **Integrated conservation management of adjoining creek frontage blocks.** Conservation management of adjoining bushland to the north of the college (particularly the creek frontage) is urgently required. These blocks are more degraded than the college land and unless managed appropriately will cause a negative impact, particularly as a weed and vermin source. Landowners should be encouraged to undertake conservation management which is integrated with the management of the college nature reserve. Together, the blocks form viable faunal habitat. Proper management would improve the effectiveness of the creek habitat link.
 - **Scope for environmental education classes.** The nature reserve offers scope for environmental education and the school is urged to move decisively in this direction. Participation by students will provide valuable training in awareness and understanding of the concepts of nature conservation.
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Site 55 Kalbar Road–Research Township

Map Reference:	7922 387262 (Kalbar Road Reserve). One minute lat/long grids include 37° 41' x 145° 10', 37° 42' x 145° 10'.
Location/Size:	North-west end of Kalbar Road at Research. Approximately 60 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: old Maroondah aqueduct, Kalbar Road Reserve and Research Park (Shire of Nillumbik). Private: formerly bushland and orchards; now becoming residential.
Landforms:	Foothill (see YLH A). Elevation is 70–110 m.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 3

Reference stands: Yellow Box–Red Stringybark (hill-crest) box–stringybark woodland (11.2)

Relatively intact and extensive stands: nil

Endangered species: Rosella Spider-orchid

Critical assemblages or populations: Box–Stringybark Woodland Critical Conservation Area (Kalbar Road Reserve): the most intact stand of Yellow Box–Red Stringybark box–stringybark woodland (11.2) remaining in NEM. Few intact and extensive stands remain in GM. The plant diversity and representativeness of the Kalbar Road Reserve is amongst the highest known in 11.2 in GM. High orchid diversity and population density at Kalbar Road Reserve: the Research area was one the finest (most diverse, significant and interesting) for orchids near Melbourne and contained an abundance of *Diuris*, *Caladenia* and *Pterostylis* species. It has rapidly and almost totally undergone residential development over the last two decades.

FAUNAL SIGNIFICANCE: Site 55 Kalbar Road–Research Township

Assessment: Regional—Category 2 (C, D, E)

55^a: 37° 41' x 145° 10'; Kalbar Road Reserve, Research

55^b: 37° 42' x 145° 10'; Research township

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Unranked. 55^b: Swift Parrot (seen prior to survey period in April 1984 and late February 1985 passing over Research township)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Regional. 55^a: 6 species at Kalbar Road bushland on 8 September 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 55^{ab}: over 70 species

b. Native birds

Regional. 55^{ab}: over 50 species

c. Native mammals

Regional. 55^a: 9 species

d. Herpetofauna

Regional. 55^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 55^a: 2 species. **55^b:** 1 species

e. Regionally depleted fauna (R4 species)

Regional. 55^a: 2 species. **Birds:** Leaden Flycatcher, Speckled Warbler

Local. 55^b: 1 species. **Birds:** Leaden Flycatcher

f. Regionally restricted fauna (R5 species)

Local. 55^a: 5 species. **Birds:** Rainbow Lorikeet, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink. **Frogs:** Striped Marsh Frog

Local. 55^b: 1 species. **Birds:** Rainbow Lorikeet

Outlook

Habitat loss and fragmentation from ensuing development will eliminate most of the native mammal and reptile species. Many of the birds will follow as alien species populations expand into bushland refugias. The faunal significance by then will likely have fallen from Regional to Local.

FAUNA

Rare or Threatened Fauna

Bb 55^b: Swift Parrot. Seen on two occasions (April 1984 and late February 1985) passing over Research township (Joy Pagon pers. comm.). They possibly still visit to feed on leaf psyllids in Yellow Box–Red Stringybark box–stringybark woodland (11.2) such as at Kalbar Road Reserve and Yellow Box–Candlebark valley forest (31.1).

Other Significant Fauna

Birds

55^a: Avifauna of Kalbar Road. The Yellow Box–Red Stringybark box–stringybark woodland (11.2) contains a number of woodland birds not recorded from the urban sections. These include the Shining Bronze-Cuckoo, Scarlet Robin, Speckled Warbler, Buff-rumped Thornbill, Brown-headed Honeyeater, White-eared Honeyeater and White-winged Chough.

55^b: Birdlist for Research township. The vegetation of the area is composed of remnant stands of Red Stringybark herb-rich foothill forest (6.1), Swamp Gum gully woodland (10.3), Red Box–Red Stringybark box–stringybark woodland (11.1) and Yellow Box–Candlebark valley forest (31.1). A fauna list for the remnant bushland area in Research township along the Research Creek upstream of Ingrams Road was provided by local bird observer, Joy Pagon. Additional significant birds on the list not seen in the site by the author include the Southern Boobook, Sacred Kingfisher and Leaden Flycatcher. The Whistling Kite was recorded in the early 1980s but has not been seen in recent years.

Reptiles and frogs

55^a: Herpetofauna of Kalbar Road. The Bougainville's Skink was recorded on the sandstone hill-crest under Yellow Box–Red Stringybark box–stringybark woodland (11.2). The Common Blue-tongued Lizard, Delicate Skink and Eastern Three-lined Skink were recorded in the grassy valley north of the reserve under remnant Yellow Box–Candlebark valley forest (31.1) No snakes were recorded in the site in the course of the survey, which is indicative of urban encroachment. Six species of frogs including the Striped Marsh Frog were recorded at Kalbar Road bushland on 8 September 1992. Several Victorian Smooth Froglets were heard calling on 27 March 1992 from the sheltered hill-slopes near the aqueduct (remnant Red Stringybark herb-rich foothill forest; 6.1).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective habitat links remain. A narrow bushland link remains via the aqueduct to the Wombat Drive–Piper Crescent Research site. Other links are severed by residential development. When the site was surveyed in the late 1980s it still had faunal significance but now the only biological values remaining reside in the flora of Kalbar Road Reserve.</p>	
<p>Acute loss and degradation of habitat and severance of habitat links. Without adequate reservation and management of habitat, clearing for residential development over the next few years will see the elimination of most of the significant plant and animal species from the site. The Research–Eltham box–stringybark woodland orchid flora was one of the most diverse near Melbourne. Over 95% of the orchid habitat has been eliminated by housing and much of the remainder has become degraded.</p>	<p>Box–Stringybark Woodland Critical Conservation Area. The ground flora at Kalbar Road Reserve is diverse and intact. Surveys to date have recorded almost 200 native plant species, including 36 orchid species. Approximately 3 ha of the woodland (a component of which is an existing council reserve) is proposed as the Critical Conservation Area in NEM for the threatened Yellow Box–Red Stringybark box–stringybark woodland (in accordance with the Regional Habitat Link Strategy). The woodland has affinity with vegetation types of inland Victoria. The sandstone flora is considered a biogeographic relict.</p> <p>The area is under a minimum size to maintain viable populations of many of its flora and fauna species. This deficiency will have to be countered by an increased level of management. Any further loss in habitat can be directly equated to loss in flora and fauna species and values.</p>
Other Issues	
<p>Urban development proposal north of Kalbar Road Reserve. A considerable proportion of the area is proposed for subdivision. It is rich in wildflower species. Other issues include habitat fragmentation and disturbance, weeds, hare grazing and trampling. Interference from orchid diggers and photographers is likely to occur.</p>	<p>Preservation of the Kalbar Road orchid assemblage. There is a public open space requirement of 5% (about 0.2 ha) on proposed development at Kalbar Road. This is inadequate to preserve the orchid assemblage, particularly species with complex ecological requirements such as spider-orchids. The proposed Critical Conservation Area would be the minimum necessary to maintain the assemblage. This will require intensive conservation management. The key process would be the determination of the area as Critical Habitat for the endangered Rosella Spider-orchid under the Flora and Fauna Guarantee Act.</p>

Ongoing degradation and disturbance—tracks, weeds, vermin and rubbish dumping. As elsewhere amidst housing development in NEM, remnant bushland at Kalbar Road is being neglected, fragmented and degraded (see Wombat Drive–Piper Crescent and St Helena sites), though the Shire of Nillumbik is upgrading its management of the reserve area. Vehicle tracks (now mostly blocked off) and pedestrian tracks criss-cross the wildflower area. The wildflowers are being trampled. Dumping of household and building refuse and garden prunings is occurring. The rubbish provides habitat for slugs and snails which feed on the orchids. Trail-bike and horse riding occurs on weekends. Weeds have established and the tracks and disturbance have enabled the spread of Large Quaking-grass, Brown-top Bent and Annual Veldt Grass. Spanish Heath, Boneseed, Montpellier Broom and Cootamundra Wattle are present. The gully is infested with Blackberries which harbour vermin such as hares and Black Rats.

The critical habitat is the area containing or potentially containing the orchid and the habitat of its specific and essential insect pollinator. **Acquisition and management of a larger reserve.** Survival of the Rosella Spider-orchid is dependent on the inclusion of about 1 ha of land occurring north-west of the existing reserve. It also requires intensive management including hand pollination and weed control. Negotiations should be pursued by NRE and the Shire of Nillumbik with the developer over the need for acquiring this land. The area will need special protection during the subdivision/building phase.

Follow-up Management of Kalbar Road Reserve

Local community conservation group. The formation is a necessity. Education brochures and signs (e.g. prohibiting the dumping of rubbish and collection of wildflowers) will be required.

Weed control. Surrounding housing and disturbance is causing a major weed invasion in the bushland. If a weed eradication program is not quickly commenced, the orchid diversity in the bushland will decline rapidly. A burn in late spring–early summer is the best timing to control annual species such as the Large Quaking-grass. Management would require broad-scale weed removal including weed burning. A long-term weed eradication program will need to be formulated.

Internal fencing to protect wildflower areas. A system of paths and hare-proof fences similar to that at St Helena Flora Reserve will need to be constructed.

Plant rescue operation from surrounding development. Significant plants should be salvaged from proposed development and relocated into the reserve.

Site 56 Stony Creek–Pigeon Bank–Laughing Waters Creek

- Map Reference:** 7922 422229 to 7922 432261 (Stony Creek); 7922 422233 (Professors Hill Flora Reserve); 7922 423245 (The Chase); 7922 385218 to 7922 406241 (Laughing Waters Creek/Gumtree Road). One minute lat/long grids include 37° 41' x 145° 13', 37° 42' x 145° 13', 37° 43' x 145° 10' and 37° 43' x 145° 12'.
- Location/Size:** The catchments of the Stony Creek upstream of the Research–Warrandyte Road, Laughing Waters Creek upstream of Mt Pleasant Road and the Pigeon Bank Gully between the Kangaroo Ground–Warrandyte Road and Henley Road. Approximately 420 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Flora Reserve (Professors Hill—NRE); Water Frontage (Stony Creek—NRE); Maroondah Aqueduct Reserve (Melbourne Water); The Chase (a section owned by the Shire of Nillumbik). Private: bushblocks and farmlets and residential areas.
- Landforms:** Foothill and volcanic plain (see YLH A). Elevation is 30–230 m (KG Hill).
- Landscape:** The Professors Hill–Chase Land at North Warrandyte supports relatively extensive and intact foothill landscapes and vegetation. Areas elsewhere within the management unit are fragmented or degraded.

Scientific and Educational Values

Rehabilitation and management. Friends of Professors Hill and the staff and Friends of Warrandyte State Park (FOWSP) are active at Professors Hill and the adjacent section of the Stony Creek.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: nil

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Manna Gum gully woodland (10.1); Messmate–Swamp Gum gully woodland (10.2)

Vulnerable species: Wine-lip Spider-orchid

Rare species (potentially threatened): *Caladenia* aff. *carnea*

Critical assemblages or populations: Wine-lip Spider-orchid at Professors Hill (39 flowering on 28 October 1991; third largest population known in NEM)

FAUNAL SIGNIFICANCE: Site 56 Stony Creek–Pigeon Bank–Laughing Waters Creek

Assessment: Regional—Category 1 (B, C, D, E, F)

56^a: 37° 41' x 145° 13'; Kangaroo Ground

56^b: 37° 42' x 145° 12'; upper Stony Creek/The Chase, North Warrandyte

56^c: 37° 42' x 145° 13'; Pigeon Bank, North Warrandyte

56^d: 37° 43' x 145° 10'; Gumtree Road, Research

56^e: 37° 43' x 145° 12'; lower Stony Creek/Professors Hill, North Warrandyte

56^f: 37° 43' x 145° 13'; Blooms Road, North Warrandyte

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

- Regional. 56^a:** Large Ant-blue butterfly (hill-topping male) recorded from a hill at Kangaroo Ground in 1987.
Unranked. Genoveva Azure recorded at Kangaroo Ground in the 1970s
- c. Rare fauna
- Regional. 56^f:** nesting Powerful Owl at Blooms Road in spring 1994
- Regional. 56^d:** road-kill Brush-tailed Phascogale near Laughing Waters Creek at Gumtree Road crossing in early April 1987
- Regional. 56^e:** Broad-finned Galaxias in the Stony Creek
- C. DIVERSITY: Species/Assemblage Richness—point census/trapping
- k. Frogs
- Local. 56^d:** 4 species including the Victorian Smooth Froglet at Gumtree Road on 8 September 1992
- Local. 56^e:** 4 species along lower Stony Creek on 22 January 1991
- l. Reptiles
- Regional. 56^d:** 6 species including the Delicate Skink, Bougainville's Skink and Lowland Copperhead at Gumtree Road on 8 September 1992
- D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey
- a. All native vertebrate fauna
- Regional. 56^e:** 89 species
- b. Native birds
- Regional. 56^e:** 62 species. **56^c:** 61 species. **56^d:** 60 species
- c. Native mammals
- Regional. 56^e:** 11 species. **56^c:** 8 species
- d. Herpetofauna
- Regional. 56^e:** 16 species
- f. Butterflies
- Regional. 56^d:** 26 species
- E. REPRESENTATIVENESS: Significant Species—reference grid survey
- a. GM critical fauna (R1-R4 species)
- Local. 56^e:** 7 species. **56^c:** 6 species
- b. Regionally endangered fauna (R1 species)
- Regional. 56^a:** 1 species. **Butterflies:** Large Ant-blue
- c. Regionally vulnerable fauna (R2 species)
- Regional. 56^e:** 2 species. **Birds:** White-throated Gerygone. **Fish:** Broad-finned Galaxias
- d. Regionally rare fauna (R3 species)
- Regional. 56^c:** 4 species. **Birds:** Little Corella, Fork-tailed Swift, Masked Woodswallow, White-browed Woodswallow
- Regional. 56^e:** 3 species. **Birds:** Spotted Quail-thrush. **Reptiles:** Eastern Small-eyed Snake, White-lipped Snake
- Regional. 56^b:** 1 species. **Birds:** White-browed Woodswallow (nested along upper Stony Creek)
- e. Regionally depleted fauna (R4 species)
- Regional. 56^c:** 2 species. **Birds:** Whistling Kite, Peregrine Falcon
- Regional. 56^e:** 2 species. **Birds:** Leaden Flycatcher, Bassian Thrush
- Local. 56^d:** 1 species. **Butterflies:** Flame Skipper
- f. Regionally restricted fauna (R5 species)

Regional. 56^e: 11 species. **Birds:** Painted Button-quail, Brush Bronzewing, Australian Hobby, Little Lorikeet, Rose Robin, Olive Whistler, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, Bougainville's Skink. **Frogs:** Southern Toadlet

Regional. 56^d: 10 species. **Birds:** Rainbow Lorikeet, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Banks Brown, Meadow Argus, Dark Purple Azure

Local. 56^c: 4 species. **Birds:** Little Eagle, Australian Hobby, Little Lorikeet, Purple-crowned Lorikeet

g. Nesting birds of prey

Regional. 56^b: Wedge-tailed Eagle at The Chase in spring 1990

Regional. 56^f: Powerful Owl at Blooms Road in spring 1994

F. POPULATION DENSITY: Viability and Abundance—point census

m. Regionally rare fauna (R3 species)

Regional. 56^c: 30 Little Corellas feeding on ripening Hawthorns and Sweet Briar on Pigeon Bank in January 1986

Outlook

The opening up of The Chase for subdivision and general habitat degradation elsewhere is reducing faunal values. Several regionally threatened fauna species, ground mammals and reptiles and the nesting Wedge-tailed Eagles are under threat. The conservation status of the site will likely decline from Category 1 to Category 2.

FAUNA

Rare or Threatened Fauna

Bb 56^a: Large Ant-blue butterfly. Recorded (predominantly males) hill-topping at Kangaroo Ground on 11 occasions from 1981 to 1987 (Douglas & Braby 1992).

Bc 56^f: Powerful Owl. Nested at Blooms Road, North Warrandyte in spring 1994. From 1991 to 1993 their nest site was located at Pound Bend (site 58). For discussion see site 57.

Bc 56^c: Brush-tailed Phascogale. A road-killed juvenile male was found in Red Box–Red Stringybark box-stringybark woodland (11.1) near the Laughing Waters Creek at the Gumtree Road crossing in early April 1987. Around the same time another was trapped nearby at Birrarung on Laughing Waters Road (see site 57). Males become independent in mid-summer and range widely. A half dozen road-killed males were obtained from late summer to mid-autumn during the study. Interviews with locals in the Mt Pleasant Road–Gumtree Road area suggest that the species was previously widespread but declined with the residential development between Eltham and Research during the late 1970s and early 1980s. Habitat loss and degradation and likely cat predation is threatening the survival of the species in the management unit.

Bc 56^e: Broad-finned Galaxias. Stony Creek.

Other Significant Fauna

Birds

Ed 56^c: Hill-topping woodswallows and swifts over Pigeon Bank. This area and nearby Kangaroo Ground Hill are some of the best areas in NEM for viewing aerial insectivores. Each is a prominent and sharp ridgeline surrounded by deep valleys. During summer, the warm, mid-afternoon updraught created by the terrain sweeps insect swarms into the air. These attract aerial feeders such as the White-browed and more rarely, Masked Woodswallows (large numbers in summer 1985/86 and every three to five years), White throated Needletail (each year) and about once in eight to ten years, the Fork-tailed Swift (several hundred in late February 1986, preceding a large thunderstorm).

Ed 56^e: Spotted Quail-thrush—winter visitor to lower Stony Creek. This species was recorded at lower Stony Creek upstream of where Floods Road joins Stony Creek Road on 28 August 1990. This was several months prior to the opening up of The Chase land to the north. The combination of moderately dense

shrubland and tussock grassland and open box-stringybark woodland provided ideal habitat for ground and shrub layer birds. The quail-thrush was seen amongst Grey Tussock-grass and Silver-top Wallaby-grass on the east-facing slopes. The habitat was Red Stringybark (exposed valley) box-stringybark woodland (11.3) with a grass cover of about 50%, areas of rock outcrop, bare ground and leaf litter, a light cover of low shrubs (e.g. Golden Bush-pea, Prickly Moses and Small-leaf Parrot-pea) and tall shrubs (e.g. Blackwood, Sweet Bursaria and Cherry Ballart).

Ef **56^e: Painted Button-quail, Brush Bronzewing, Rose Robin and Olive Whistler—winter visitors to lower Stony Creek.** These species and the Crescent Honeyeater were recorded at lower Stony Creek upstream of where Floods Road joins Stony Creek Road on 28 August 1990. A pair of button-quail was present under Red Stringybark box-stringybark woodland (11.3) on the east side of the Stony Creek valley. The ground layer consisted of grass tussocks and low shrubs (Narrow-leaf Bitter-pea and Gold-dust Wattle) and tall shrub thickets (e.g. Golden Wattle).

The Brush Bronzewing, Rose Robin and Olive Whistler were recorded in the dense Burgan, Black Wattle and Blackwood along Stony Creek under Manna Gum gully woodland (10.1). The Crescent Honeyeater was feeding in the same area in flowering Common Correa. With the exception of the honeyeater, which also visits ornamental shrubs in bushland gardens, the other species may stop visiting the area because of disturbance, loss of habitat and increased predation pressure from cats.

Eg **56^b: Wedge-tailed Eagle.** A pair nested and one young was reared at The Chase in spring 1990. They had nested on previous occasions. Wedge-tailed Eagles seek secluded breeding sites. Bushblock subdivision has threatened this seclusion. Prior to this time the middle and upper section of Stony Creek was the least accessible and settled and most secluded part of North Warrandyte. The birds are often seen soaring over the hills of Pigeon Bank and Kangaroo Ground immediately to the north. The open country of the Dry Creek valley to the north-west is a favoured hunting area. The birds received a degree of publicity and human disturbance in 1990. An access road was built on the west side of Stony Creek in 1991 and subdivision of blocks for housing commenced. Until the houses were built, this opened access to cars and trail-bikes. It is possible that the birds will ultimately abandon nesting there.

56^e: Breeding Rufous Fantails along lower Stony Creek. On 22 January 1991, several pair of Rufous Fantails were nesting in thickets along Stony Creek.

Mammals

56^e: Koala. One was seen in a Swamp Gum along the creek on 28 August 1990. This animal would likely be part of the Yarra River population.

Reptiles

Ed **56^e: White-lipped Snake and Eastern Small-eyed Snake.** The White-lipped Snake was seen sunning by a log near the corner of Stony Creek Road and Floods Road on 28 August 1990. The habitat was Yellow Box-Candlebark valley forest (31.1). This species was common in the 1970s in the grassy, sandstone valley of Stony Creek Road (as was the Common Everlasting). The area has been built up with houses, the grass is slashed and logs and rocks have been removed. The snake is now locally rare. The Eastern Small-eyed Snake was located under a rock in Red Box-Red Stringybark box-stringybark woodland (11.1) on the skeletal siltstone ridgeline at the north end of Danita Drive on 22 January 1991. The ridgeline now contains houses.

The small-eyed snake is a nocturnal hunter. The prey of both snakes is predominantly small skinks. The section where the white-lipped snake occurred contained a high diversity of skinks. The Weasel Skink and Delicate Skink were common (along with the locally rarer Eastern Three-lined Skink), in the grassy valley. The Bougainville's Skink was under loose rock in Yellow Box-Candlebark grassy woodland to the south of Floods Road, and to the north under Red Stringybark box-stringybark woodland (11.3). The Southern Water Skink inhabits Stony Creek (Manna Gum gully woodland; 10.1). The Lowland Copperhead occurs in all the mentioned habitats.

The only skink located near the barer ridgeline inhabited by the small-eyed snake was the Garden Skink. Since The Chase was made accessible by road, logs have been cleared from the ground by firewood gatherers.

This has depleted the habitat of the White-lipped Snake and several of its prey. Cats accompanying the subdivision will prey on the larger reptiles. Humans and cars will kill the snakes. Neither snake species has survived in bushland nearer built-up areas (e.g. Eltham Copper Butterfly site and Kalbar Road site).

Butterflies

56^d: Gumtree Road/Laughing Waters Creek. Records of 24 species were provided by Michael Braby. Each is presumed to have bred locally. These include the Doubleday's Skipper, Donnysa Skipper, Flame Skipper, Spotted Skipper, Bright Shield Skipper, Phigalia Skipper, Phigalioides Skipper, Banks Brown (nearby in the gully at Shorts Road), Meadow Argus and Dark Purple Azure. Larvae of the Doubleday's Skipper likely breed on Weeping Grass, which is abundant in the gully under Messmate-Swamp Gum gully woodland (10.2). The larvae of the Flame Skipper likely breed on Thatch Saw-sedge, which is abundant on the sheltered hill-slopes under Red Stringybark herb-rich foothill forest (6.1).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Partially intact habitat links to the Pound Bend-Black Flat site of Warrandyte State Park along the Stony Creek	
<p>Land clearing for bushblock subdivision and severance of habitat links. Substantially cleared farmland lies to the north and housing is advancing from the south. Housing development is severing habitat links and is fragmenting the stands of box-stringybark and grassy woodland. Many forest species will be eliminated from the site over the next 10 years. See Wombat Drive-Piper Crescent site and Kangaroo Ground-St Andrews Road Red Ironbarks site.</p>	<p>Strengthen habitat links. Further fragmentation of bushland must be prevented, or elimination of species will result. The radiating links from the middle Yarra River are being rapidly eliminated. This is fragmenting faunal populations along the Yarra. An effective plan needs to be devised for retaining and enhancing these links</p> <p>Protection of conservation values on freehold bushland. The vast majority of bushland in the site is on freehold land. Managing conservation values and protection of the site as a habitat link to the Yarra needs to be promoted. An integrated land-use and management plan for these areas should be developed. Protection and enhancement through revegetating broken links and broadening bushland strips along streams and valleys will be required to maintain the present native fauna populations.</p> <p>Habitat protection group. The Friends of Warrandyte SP has been active for several years at Professors Hill, Brogil Gully and Stony Creek..</p>

YLH B YARRA RIVER DIAMOND CREEK TO JUMPING CREEK

This management unit consists of one site of state faunal significance (site 57) and one site of regional faunal significance (site 58) and surrounding land that forms (restricted) habitat links.

Map Reference: 7922 370217 to 7922 449218 (Yarra River).

Location/Size: Yarra River and local catchments from 300 m upstream of the Diamond Creek to downstream of Jumping Creek including the eastern section of Yarra Valley Park and western section of Warrandyte State Park. Approximately 2100 ha.

Municipality: Shire of Nillumbik and City of Manningham.

Physical Features

The management unit forms part of the lowland hills of the Eastern Uplands. The landscape contains the most downstream section of the middle Yarra River valley surrounded by undulating and heavily folded hills and valleys. Stony and Laughing Waters creeks enter the Yarra River from the north side and Mullum Mullum and Anderson creeks enter from the south side.

Landforms

Foothill: hill-crests, hill-slopes, gullies, valleys, creeks, river valley, gorges, cliffs, terraces, rapids and diversion tunnel, artificial wetlands (floodplain), dams and gold mines. Elevation is 20–140 m.

Hydrology

The Yarra River is a large, perennial stream. The physiography of the river is relatively youthful and differs from the mature system downstream on the alluvial plains. The changeover from the Yarra Lowland Hills to the Alluvial Plains is marked by topographic, vegetation (e.g. replacement of Manna Gum by River Red Gum) and stream morphology changes. In the Yarra Lowland Hills, the river has formed a winding, incised valley and contains fast-flowing rapids and cascades, steep banks, cliffs, rock bars and sand bars. It is characterised by gorges and rapids. There is a series of faster-moving rapids (about six in the 2 km section between Alexander Road and Mullum Mullum Creek) and slow-flowing deep water pools (to 8 m depth) on the convex side of bends. These contain sand bars lined with reeds on the concave side of the river. Pound Bend is the largest entrenched river meander in the Yarra Valley and one of the largest in Victoria.

The surrounding terrain contains steep slopes with deep, damp gullies and ephemeral cobble streams. The Stony Creek is now perennial as it is fed by overflow from the Maroondah Aqueduct. Mullum Mullum Creek is youthful and contains a deep, narrow valley supporting riparian forest. It may have been a former tributary of the Dandenong Creek, captured by the Yarra with the subsidence of land south of the Yarra Fault. Mullum Mullum Creek is fed predominantly by urban runoff during summer-autumn. Several smaller streams enter the Yarra, the largest of which is Andersons Creek.

Rainfall: 720–790 mm.

Site 57 Pettys–Sweeneys–Paddles–Morrison’s–Glynns

- Map Reference:** 7922 370217 to 7922 413223 (Yarra River from 300 m upstream of the Diamond Creek to opposite the end of Glynns Road, about 900 m upstream of the Pound Bend Tunnel exit). One minute lat/long grids include 37° 43' x 145° 11' and 37° 44' x 145° 09' to 145° 11'.
- Location/Size:** Yarra River from Pettys to Pound Bend. Approximately 720 ha.
- Municipality:** Shire of Nillumbik and City of Manningham.
- Land Tenure/Use:** Public: Melbourne Parks and Waterways (Yarra Valley Park); NRE (Warrandyte State Park–Pound Bend Tunnel and 500 m of the North Warrandyte river frontage upstream of the tunnel exit). Private: bushblocks and bushland/farmlets adjoining encroaching residential areas.
- Landforms:** Foothill (see YLH B). Elevation is 20–140 m.

Natural Heritage Values

Landscape. The site forms the meeting point of the lowland hills with the lowland alluvial plains (downstream). It is the most intact site representative of the hills to alluvial plains transition remaining in NEM. It contains the most downstream occurrences of extensive and intact stands of foothill woodland/forest and their fauna in the Yarra system.

Scientific and Educational Values

Rehabilitation and management. Yarra Valley Park revegetation programs at Pettys, Glynns and Paddles and rare plant protection programs at Morrisons. Friends of the Yarra Valley Park group. (Note: Paddles is now known as Tikalara Park).

Public interpretation. Ranger activities, displays and nature education program.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Manna Gum (riverbank) riparian forest (5.1; Morrisons southern peninsula and Mappin property in YVP); Manna Gum (floodplain terrace) riparian forest (5.2; Morrisons southern peninsula); Swamp Gum gully woodland (10.3; Morrisons NE section and adjoining Drake property); Yellow Box–Red Stringybark box–stringybark woodland (11.2; Morrisons NE section); Long-leaf Box escarpment woodland (13.1; Morrisons NE section and southern peninsula); Yellow Box escarpment woodland (13.2; Morrisons southern peninsula); Yellow Box–Candlebark grassy woodland (14.6; Killeavey driveway on Morrisons); Muttonwood riparian scrub (18.1; Longridge and Glynns); Golden Wattle cliff/escarpment shrubland (20.4; Naughton Avenue)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Narrow-leaf Peppermint herb-rich foothill forest (6.2); Manna Gum gully woodland (10.1); Red Box escarpment woodland (13.3); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2); Yellow Box–Candlebark valley forest (31.1; valley of Laughing Waters Creek on Morrisons)

Vulnerable species: Spotted Duckweed, Wine-lip Spider-orchid, Leafy Greenhood, Clover Glycine

Rare species: Stream Club-sedge, Plains Flax-lily (*Dianella* aff. *longifolia*), Caladenia (*Caladenia* aff. *carnea*), Bearded Greenhood, Billy-buttons (*Craspedia* sp. *nova*), Slender Tick-trefoil, Yarra Gum

Critical assemblages or populations: Yarra–Yellow Box Woodlands Ecological Reference Area and Strategic Habitat Link. The conservation status of the site is listed Category 1 due to it supporting nine reference stand habitats and a high diversity of regionally rare or threatened species. The habitat significance is listed very high on the basis that five of the reference stands are threatened (10.3, 11.2, 13.1, 13.2 and 14.6) and because of the presence of 11 Victorian rare or threatened (VROT) species. Morrisons: box–stringybark woodland orchid flora, finest stands of Yellow Box–Candlebark grassy woodland in NEM and riparian forest and escarpment woodland

reference stands; regionally endangered and disjunct flora of biogeographic significance at Naughton Avenue cliffs (e.g. Bristly Cloak-fern and Plains Flax-lily) and Morrisons southern peninsula (e.g. Leafy Greenhood and Dense Crassula)

FAUNAL SIGNIFICANCE: Site 57 Pettys–Sweeneys–Paddles–Morrisons–Glynns

Assessment: State—Category 1 (B, C, D, E, F); Regional (B, C, D, E, F)

57^a: 37° 43' x 145° 10'; Yarra Valley Park–Morrisons (northern section)

57^b: 37° 43' x 145° 11'; YVP–Laughing Waters Road to Glynns Road

57^c: 37° 44' x 145° 09'; YVP–Petty/Sweeney & lower Mullum Ck/Paddles (west)

57^d: 37° 44' x 145° 10'; YVP–Paddles (east) and Morrisons (south)

57^e: 37° 44' x 145° 11'; YVP Glynn/Naughton–Pound Bend Tunnel/Warrandyte SP

A. Cited Zoological Significance

State. Yarra River and Little Yarra River site (Pound Bend Tunnel and adjacent section of the Yarra only): Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 57^{cde}: single sightings of the Regent Honeyeater: 1 bird in Swamp Gums at Sweeneys Flats on 31 October 1989; 1 bird in flowering Manna Gums at Morrisons southern peninsula on 10 March 1995; 2 birds in flowering Manna Gums at the Pound Bend Tunnel exit on 8 March 1988

b. Vulnerable fauna

State. 57^e: Australian Grayling (Glynns rapids), Large Ant-blue butterfly (Naughton Avenue cliffs)

State. 57^c: Swift Parrot (two sightings at Sweeneys; 9 May 1989 and 15 September 1996)

Regional. 57^d: Swift Parrot (Reynolds Road/Morrisons; 15 September 1996)

c. Rare fauna

State. 57^e: Powerful Owl, Brush-tailed Phascogale, Common Bent-wing Bat, Large-footed Myotis

State. 57^b: Grey Goshawk, Barking Owl, Powerful Owl, Brush-tailed Phascogale

State. 57^c: Lewin's Rail, Baillon's Crake, Blue-billed Duck, Black Falcon

Regional. 57^d: Grey Goshawk, Barking Owl, Powerful Owl

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 57^e: 23 species including the Brown Quail, Buff-banded Rail, Australian Spotted Crake (breeding), Darter, Latham's Snipe, Great Egret, Nankeen Night Heron (two juveniles) and Australian Shelduck at Glynns Wetland on 29 November 1994

Regional. 57^c: 21 species including the Australian Spotted Crake, Hoary-headed Grebe, Lewin's Rail (breeding), Black-fronted Dotterel (breeding), Latham's Snipe, Nankeen Night Heron, Australian Shelduck, Musk Duck and Australasian Shoveler at Pettys Wetland on 5 February 1991

f. Breeding migratory insectivores

State. 57^b: 12 species including the Sacred Kingfisher, Satin Flycatcher, White-throated Gerygone, White-winged Triller and Rufous Songlark at Birrarung/McCullaghs and the adjoining section of the Yarra River on 4 December 1987

g. Breeding parrots

State. 57^d: 9 species including the Rainbow Lorikeet, Musk Lorikeet, Little Lorikeet, Long-billed Corella, Crimson Rosella and Red-rumped Parrot in Manna Gums, Yellow Box and Candlebarks at the south end of Reynolds Road on 18 October 1994

h. Bats

Regional. 57^b: 6 species at McCullaghs on 22 January 1991.

Regional 57^d: 4 species including the Gould's Long-eared Bat at Morrisons on 22 January 1991

i. Arboreal mammals

Regional. 57^b: 4 species including the Brush-tailed Phascogale and Sugar Glider at Birrarung/Laughing Waters Road on 4 April 1987

j. Ground mammals

Regional. 57^b: 5 species including the Brown Antechinus, Black Wallaby and Common Wombat at Birrarung on 4 April 1987

Regional. 57^d: 5 species including the Platypus and Water Rat at Morrisons southern peninsula on 22 January 1991

k. Frogs

Regional. 57^d: 7 species including the Growling Grass Frog and Striped Marsh Frog at lower Laughing Waters Creek/Reynolds Road on 22 January 1991

l. Reptiles

Regional. 57^d: 7 species including the Tree Dragon, White's Skink, Weasel Skink, Southern Water Skink, Blotched Blue-tongue Lizard and White-lipped Snake at Morrisons southern peninsula on 22 January 1991

m. Freshwater fish

Regional. 57^e: Short-headed Lamprey, Short-finned Eel and Macquarie Perch by mesh net and Australian Smelt by electrofishing upstream of Pound Bend Tunnel exit on 22/23 July 1993

Regional. 57^c: Southern Pigmy Perch and Short-finned Eel by fyke-net at Pettys Wetland on 5 February 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 57^d: 170 species. **57^e:** 157 species

Regional. 57^c: 129 species. **57^b:** 126 species

b. Native birds

State. 57^d: 141 species (second highest ranking grid in NEM)

Regional. 57^e: 114 species. **57^c:** 109 species. **57^b:** 89 species

c. Native mammals

Regional. 57^b: 19 species. **57^e:** 16 species. **57^d:** 15 species

Local. 57^c: 6 species

d. Herpetofauna

Regional. 57^b: 18 species. **57^e:** 15 species. **57^d:** 14 species. **57^c:** 10 species

e. Freshwater fish

State. 57^e: 9 species (see *Cm* plus Common Galaxias, Australian Grayling, Murray Cod, Freshwater Blackfish and Tupong)

Regional. 57^c: 4 species (see *Cm* plus Macquarie Perch and Murray Cod)

f. Butterflies

State. 57^d: 33 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 57^d: 30 species. **57^e:** 29 species. **57^c:** 27 species

Regional. 57^b: 16 species

b. Regionally endangered fauna (R1 species)

State. 57^e: 4 species. **Birds:** Regent Honeyeater, Little Friarbird. **Fish:** Australian Grayling. **Butterflies:** Large Ant-blue

Regional. 57^d: 2 species. **Birds:** Grey Goshawk, Regent Honeyeater

Regional. 57^c: 1 species. **Birds:** Regent Honeyeater

Regional. 57^b: 1 species. **Birds:** Grey Goshawk

c. Regionally vulnerable fauna (R2 species)

State. 57^e: 10 species. **Birds:** Azure Kingfisher, Yellow-tufted Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Bent-wing Bat, Large-footed Myotis. **Frogs:** Peron's Tree Frog. **Fish:** Short-headed Lamprey, Australian Smelt, Freshwater Blackfish, Tupong

State. 57^c: 6 species. **Birds:** Lewin's Rail, Baillon's Crake, Black-tailed Native-hen, Black-winged Stilt, Black Falcon. **Frogs:** Peron's Tree Frog

State. 57^d: 6 species. **Birds:** Barking Owl, Red-capped Robin, Cicadabird. **Frogs:** Peron's Tree Frog. **Butterflies:** Dingy Dart, Bright Copper

Regional. 57^b: 5 species. **Birds:** Barking Owl, Azure Kingfisher, White-throated Gerygone, Fuscous Honeyeater. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

State. 57^c: 9 species. **Birds:** Australian Spotted Crake, Darter, Australasian Shoveler, Blue-billed Duck, Musk Duck, Pink Robin. **Reptiles:** Broad-shelled Tortoise. **Fish:** Murray Cod, Macquarie Perch

Regional. 57^d: 6 species. **Birds:** Darter, Collared Sparrowhawk, Fork-tailed Swift, Pink Robin. **Mammals:** Gould's Long-eared Bat. **Reptiles:** White-lipped Snake

Regional. 57^e: 7 species. **Birds:** Australian Spotted Crake, Darter, Collared Sparrowhawk, Little Corella. **Fish:** Common Galaxias, Murray Cod, Macquarie Perch

Regional. 57^b: 2 species. **Mammals:** Feathertail Glider. **Reptiles:** Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

State. 57^d: 16 species. **Birds:** Whistling Kite, Peregrine Falcon, Powerful Owl, Australian King-Parrot, Swift Parrot, Leaden Flycatcher, Eastern Whipbird, White-winged Triller, Bassian Thrush, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink. **Butterflies:** Flame Skipper, Spotted Brown, Blue Jewel

Regional. 57^c: 10 species. **Birds:** Buff-banded Rail, Latham's Snipe, Peregrine Falcon, Australian King-Parrot, Swift Parrot, White-winged Triller, Speckled Warbler, Rufous Songlark. **Fish:** Southern Pigmy Perch. **Mammals:** Platypus

Regional. 57^b: 8 species. **Birds:** Peregrine Falcon, Powerful Owl, Leaden Flycatcher, Bassian Thrush, White-winged Triller, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus

Regional. 57^e: 8 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Powerful Owl, Leaden Flycatcher, White-winged Triller, Rufous Songlark. **Mammals:** Platypus

f. Regionally restricted fauna (R5 species)

Regional. 57^d: 24 species. **Birds:** Painted Button-quail, Brush Bronzewing, Pied Cormorant, Nankeen Night Heron, Australian Shelduck, Little Eagle, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, Brush Cuckoo, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** Delicate Skink. **Frogs:** Striped Marsh Frog. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure

Regional. 57^b: 12 species. **Birds:** Painted Button-quail, Brush Bronzewing, Nankeen Night Heron, Little Eagle, Long-billed Corella, Brush Cuckoo, Olive Whistler, White-winged Chough. **Mammals:** Koala, Water Rat. **Frogs:** Southern Toadlet, Striped Marsh Frog

Regional. 57^e: 12 species. **Birds:** Great Egret, Nankeen Night Heron, Australian Shelduck, Australian Hobby, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** Common Long-necked Tortoise. **Frogs:** Striped Marsh Frog

Regional. 57^c: 8 species. **Birds:** Great Egret, Nankeen Night Heron, Australian Shelduck, Little Eagle, Australian Hobby, Rainbow Lorikeet. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise

g. Nesting birds of prey/parrots

State. 57^b: Grey Goshawk (stick-nest in a Manna Gum upstream of Longridge rapids on 30 November 1994); Barking Owl (pair with 2 dependent young in gully on north side of river at Longridge rapids on 30 November 1994); Peregrine Falcon (stick-nest in a Manna Gum at Longridge rapids on 30 November 1994); Long-billed Corella (Manna Gum hollow by river at Longridge rapids)

Regional. 57^{de}: Little Lorikeet and Long-billed Corella (tree-hollows near river)

Unranked. 57^d: Powerful Owl (nest-hollow in a riverbank Mountain Grey Gum until it fell around 1980)

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 57^c: flock of 20 Swift Parrots roosting at sundown in Manna Gums by the river at Sweeneys on 9 May 1989

c. Waterfowl

Local. 57^c: 68 birds of 11 species at Pettys Wetland on 5 February 1992

Local. 57^e: 47 birds of 9 species at Glynns Wetland on 29 November 1994

g. Rare/restricted colonial fauna

State. 57^e: 232 Common Bent-wing Bats and 1 Large-footed Myotis roosting in Pound Bend Tunnel on 9 May 1989

Regional. 57^e: 12 Common Bent-wing Bats trapped at the exit of Pound Bend Tunnel on 10 March 1988

h. Other fauna

Regional. 57^d: largest colony of adult/larvae Common Imperial Blue butterflies seen in NEM (several thousand) opposite Reynolds Road at Paddles on 27 January 1990

j. Electrofishing or netting rate

Regional. 57^e: return of 80 fish (see *Cm/Fl*) from the Yarra at Pound Bend Tunnel exit on 22/23 July 1993

l. Regionally vulnerable fauna (R2 species)

Regional. 57^e: 20 Macquarie Perch and 60 Australian Smelt upstream of Pound Bend Tunnel on 22/23 July 1993

Regional. 57^e: 20–30 Peron's Tree Frogs calling at Glynns Wetland on the evening of 29 November 1994

m. Regionally rare fauna (R3 species)

Regional. 57^e: school of 20 juvenile Common Galaxias at Glynns rapids (400 m downstream of Pound Bend Tunnel) on 28 December 1994

n. Regionally depleted fauna (R4 species)

Regional. 57^c: 3 Platypus recorded in a dusk survey of the lower Mullum Mullum Creek on 16 January 1995

o. Regionally restricted fauna (R5 species)

Regional. 57^c: 17 Common Long-necked Tortoises by fyke net at Pettys Wetland on 5 February 1992

Outlook

Morrison is the most significant section in Yarra Valley Park for flora and fauna and the least affected by settlement. It is accordingly proposed as the Yarra–Yellow Box Woodlands Ecological Reference Area. Many of the fauna species recorded at Morrison are absent from downstream sections of the park. The faunal significance may decline as urban development and disturbance bottleneck habitat links and isolate faunal populations. Management will need to restrict human usage/recreational pressure to low levels and make a comparable restoration effort to that conducted at Westerfolds to counterbalance declining biological values arising from settlement.

FAUNA

Note. Due to access and location within the NEROC study area, survey was mainly confined to the northern, Shire of Nillumbik, side of the Yarra.

Rare or Threatened Fauna

Ba **57^{cde}: Regent Honeyeater.** Two sightings in Manna Gum (riverbank) riparian forest (5.1) and one in Manna Gum (stream terrace) riparian forest (5.2). Two birds were observed in flowering Manna Gums at the Pound Bend Tunnel exit on 8 March 1988 (Martin Schulz pers. comm.). The next sighting was of a bird being harassed by Noisy Miners in Swamp Gums on the river terrace at Sweeneys Flats on 31 October 1989 (Glen Jameson pers. comm.). The most recent sighting was one bird in flowering Manna Gums at the southern peninsula of Morrison on 10 March 1995. The site is one of the four most important areas for the Regent Honeyeater in GM (see the Yarrambat, Cottles Bridge to St Andrews and Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands sites).

Each area contains extensive and intact stands of riparian vegetation backed by equally extensive stands of hinterland vegetation. Habitat fragmentation underlies the decline of the species. Linking these areas through functional corridors along the streamways of the Yarra River, Diamond Creek and Plenty River may be critical for the survival of the Regent Honeyeater in GM.

Bb **57^{cd}: Swift Parrot.** Riparian forest at the confluence of the Mullum Mullum Creek and downstream at the confluence of the Diamond Creek forms the most important late autumn/early winter roosting area of the Swift Parrot in NEM (see Lower Eltham Park–Thomson's site). There were two sightings at the south end of Sweeneys Lane. Twenty birds roosted in the Manna Gum riparian forest (5.1/5.2) along the Yarra at sundown on 9 May 1989. Two birds were recorded in Yellow Box–Candlebark grassy woodland (14.6) on 15 September 1996. These were feeding on Yellow Box leaf psyllids and flower buds. Also on 15 September 1996, three birds were seen in the same habitat and activity, inside the Killeavey entrance from Reynolds Road on Morrison. In the Plenty Gorge, Yellow Gum nectar is their preferred food.

Bb **57^e: Australian Grayling at Glynns rapids.** Three sub-adults (about 15 cm long) were seen at the rapids on 28 December 1994. The vegetation of the surrounding banks and islands is Muttonwood riparian scrub (18.1).

Grayling migrate between the sea and freshwater. They spawn in autumn in streams and hatchlings are swept downstream to the estuaries. These develop in marine waters for about six months before returning (usually late spring) to the streams to spend the remainder of their adult lives (four to five years).

Grayling are weak climbers, and prior to the construction of a fish-way at Dights Falls in 1993 had become extinct in the Middle Yarra. They were common at Templestowe and Heidelberg in the middle nineteenth century. The weir, which was concrete-capped into a permanent structure in the mid-1960s, provided a barrier to their upstream migration.

Grayling have the laterally compressed body shape of the Australian Smelt (also present in this section of the Yarra), but are somewhat larger and more strongly-built, with a forward-placed (shark-like) dorsal fin. They are capable of swimming in strong flows. The fish at Glynns were in one of the channels of the rapids behind an island.

Grayling are omnivorous, foraging both the deeper and surface levels. At Glynns rapids, they foraged the instream meadows of Curly and Blunt Pondweed and Lake Eel-grass. This occurred in a sandy-gravel riffle behind an island, protected from the main flow by rock breakwaters. Instream meadows at rapids may be critical as they

host invertebrate (crustacea, insects and their larvae) and plant material such as algae which is scraped from rock surfaces.

Grayling lodge their eggs amongst gravel in areas of moderate to strong flow of cool, clear, well-oxygenated water. The combination of alternating pools and riffles in the Yarra River rapids forms preferred breeding habitat. The rapids between Alexander Road and Pound Bend Tunnel are the most intact and suitable remaining for grayling in the Lower or Middle Yarra. Willows are infrequent in this section and the gravel and sand substrates of the riffles and shallow bays are relatively unsilted. Extensive bank restoration works in Yarra Valley Park and upstream in Warrandyte State Park will improve water and riparian habitat quality.

Turbid water arising from disturbance and willow and Blackberry domination of banks elsewhere will limit their breeding success (siltation prevents egg development). Competition from Roach and Brown Trout and depletion of instream meadows by European Carp will be a further limitation. The sheltered bays behind rock-bars and islands are breeding and feeding areas of the carp.

Bb 57^e: Large Ant-blue butterfly at Naughton Avenue cliffs. The larvae live in a mutualist association with the Coconut Ant (*Papyrius* sp. *nitidus* group). They are believed to prey on the ant larvae. The ants feed on honeydew secreted by the butterfly larvae. A massive ant colony dwells in the crevices of the exposed cliffs. On 22 November 1994, two adult ant-blue butterflies were observed hill-topping in Golden Wattle cliff/escarpment shrubland (20.4) at the lookout point above the ant colony.

Bc 57^c: Breeding Lewin's Rail and Baillon's Crake at Pettys Wetland. An adult Lewin's Rail with three chicks was observed amongst Knob Sedge and Common Spike-sedge (seasonal wetland; 25.7) adjacent to a stand of Swamp Paperbark at the south end of the wetland on 5 February 1991. The Baillon's Crake bred at the wetland in spring/early summer 1985/86 (Pat Fricker pers. comm.). Both species are predominantly nocturnal and rarely venture from cover during the day.

Bc 57^c: Blue-billed Duck at Pettys Wetland. Recorded during a study undertaken by Biosis Research in August 1990. Two birds in non-breeding plumage observed amongst reeds on 21 August 1990 (Sid Larwill pers. comm.).

Bc/Eg 57^{bd}: Breeding Grey Goshawk at Longridge rapids. A pair was breeding in a stick-nest overhanging the Yarra in Manna Gum riparian forest (5.1) upstream of Longridge island on 31 November 1994. Muttonwood riparian scrub (18.1) occurred downstream at the rapids surrounding the island. Manna Gum riparian forest (5.2) occurred on the adjoining floodplain terrace. The Grey Goshawk had been recently recorded nearby at Glynn's Road on 16 October 1994 (Pat Fricker pers. comm.). One was also seen near the river at the south end of Reynolds Road on one occasion in autumn in the late 1980s (Virginia Morrison pers. comm.).

The Plenty and Yarra rivers have provided the bulk of the recent sightings of Grey Goshawks in GM. All recent records have been of white phase birds and most were juveniles near watercourses during autumn post-breeding dispersal. The goshawk takes prey (usually birds) from hunting dashes through the tree canopies or from aerial pursuit. The larger female takes birds up to the size of herons, currawongs and parrots and the male takes smaller insectivorous birds and insects such as cicadas and beetles. They also take reptiles and small mammals such as young rabbits from the ground in forest openings and occasionally carrion.

The Grey Goshawk normally breeds hidden away from settlement in mountain riparian forest. The breeding record illustrates the intactness and extent of the habitat and the security offered along this section of the Yarra. Clearing or fragmentation of riparian forest and gully woodland, which provide breeding habitat, and adjacent sclerophyll forests and woodlands, which provide feeding grounds, has reduced the species in GM.

Bc 57^c: Black Falcon. Recorded on two occasions (April 1994 and September 1995) in the west section of Paddles in open paddocks with scattered Yellow Box and Candlebarks (ex-grassy woodland; 14.6) near the old farmhouse (Glen Jameson pers. comm.). A bird was sitting in a dead stag eating a pigeon in April 1994. It is possible that the falcon bred in the area. Manna Gum (creek) riparian forest (5.3) occurred nearby along Mullum Mullum Creek.

Bc/Eg 57^{bd}: Breeding Barking Owl in a gully above Longridge rapids. Two fluffy young were seen in the dense canopy of Swamp Gum gully woodland (10.3) on 31 November 1994. They were under the watchful eye of the adults which sat separately close by. The gully drains from Glynn's Road to the north-east. It

is backed by Narrow-leaf Peppermint herb-rich foothill forest (6.2) on the sheltered escarpment and Red Box escarpment woodland (13.3) on the exposed escarpment. The Barking Owl had been heard nearby at Glynn's Road on 8 October 1994 (Pat Fricker pers. comm.). They have also been recorded on several occasions near Killeavey homestead at Morrisons in Yellow Box–Candlebark grassy woodland (14.6) over recent years (Virginia Morrison pers. comm.).

Bc **57^{bde}: Powerful Owl.** In recent years their nest site has alternated between Pound Bend (site 58) from 1991 to 1993 and nearby at Blooms Road North Warrandyte in 1994 (site 56). A single bird was frequently heard in autumn 1994 at Glynn's Road (Pat Fricker pers. comm.) and one was observed within the Barking Owl territory at Longridge rapids on the evening of 31 November 1994. The breeding territory of the Barking Owl is much smaller (around 100 ha) than that of the Powerful Owl (up to 1000 ha). They can form overlapping territories as they specialise on different prey (Paul Peake pers. comm.). The Barking Owl hunts for ground mammals (mostly rabbits) in open areas while the Powerful Owl hunts for arboreal mammals (mostly Common Ringtail Possums) in the forest.

Breeding habitat of the Powerful Owl along the Yarra riverbank at Pound Bend was Manna Gum riparian forest (5.1). They formerly bred in a spout of a Mountain Grey Gum on the riverbank at Morrisons until the tree fell around 1980. Two birds were seen near Killeavey homestead in 1988 (Virginia Morrison pers. comm.). The species occupies a breeding territory of up to 1000 ha and a non-breeding home range of up to three times this area. The Yarra River corridor and availability of prey (mostly ringtail possums and rabbits) brings the owl into contact with suburban areas.

Bc **57^{be}: Brush-tailed Phascogale.** A male Brush-tailed Phascogale was trapped in Red Box escarpment woodland (13.3) at Birrarung in Laughing Waters Road on 4 April 1987. In the same week, a road-killed juvenile male was found near the Laughing Waters Creek crossing of Gumtree Road (see site 56). Phascogale hair was recorded at the entrance of several nest boxes (also 13.3) at Glynn's in 1990 (Pat Fricker pers. comm.). The site is the nearest to Melbourne along the Yarra where the phascogale has been recently recorded. They were present near the mouth of the Diamond Creek at Eltham South in the 1940s (e.g. Donald Thomson collection). Habitat loss and degradation and likely cat predation is threatening the survival of the phascogale in the management unit.

Bc **57^e: Common Bent-wing Bat and Large-footed Myotis in Pound Bend Tunnel.** See Critical Assemblages or Populations (*Fg*)

Critical Assemblages or Populations

Cf **57^b: High diversity of breeding migratory insectivorous birds at Birrarung/McCullagh's.** Twelve species including the Sacred Kingfisher, Tree Martin, Satin Flycatcher, White-throated Gerygone, White-winged Triller and Rufous Songlark were recorded breeding at Birrarung/McCullagh's on 4 December 1987. This was the only recent observation of the gerygone below Warrandyte along the Yarra.

The gerygones and a pair of Satin Flycatcher were breeding in Swamp Gum gully woodland (10.3) adjacent to Birrarung. The White-throated Gerygone feeds on foliage insects taken almost exclusively from the eucalyptus canopy. Three pair of Tree Martins and a pair of Sacred Kingfisher were breeding in Manna Gum riparian forest (5.1) along the river by the end of Laughing Waters Road. The White-winged Triller and Rufous Songlark were breeding in Red Box escarpment woodland (13.3) on McCullagh's.

Cg **57^d: High diversity of breeding parrots at south end of Reynolds Road.** Nine species including the Rainbow Lorikeet, Musk Lorikeet, Little Lorikeet, Long-billed Corella, Crimson Rosella and Red-rumped Parrot were breeding in Manna Gums, Yellow Box and Candlebarks at the south end of Reynolds Road on Morrisons and the property to the west of the road on 18 October 1994. Ample tree-hollows were present in the mature stands of Manna Gum (riverbank) riparian forest (5.1), Manna Gum (floodplain terrace) riparian forest (5.2) and Yellow Box–Candlebark grassy woodland (14.6).

Db **57^d: High diversity of birds on Morrisons.** A detailed birdlist for Killeavey was provided by Virginia Morrison. Significant species on the list that were rarely or not otherwise recorded in the management unit during the survey include the Painted Button-quail, Pied Cormorant, Darter, Collared Sparrowhawk, Grey

Goshawk, Whistling Kite, Australian King-Parrot, Barking Owl, Fork-tailed Swift, Rose Robin, Pink Robin, Bassian Thrush, Olive Whistler and Eastern Whipbird. The last four species and the goshawk and king-parrot are autumn–winter visitors from the ranges. The Barking Owl has been heard over a long period of time at Killeavey and breeds locally (upstream at Longridge rapids in November 1994). Species not seen in recent decades but recorded between 1950 and 1970 include the Australasian Bittern, White-throated Nightjar, Dollarbird and Rainbow Bee-eater.

Habitats of the southern section of Morrisons are listed under (*Df*). A reference stand of Yellow Box–Red Stringybark box–stringybark woodland (11.2) lies to the north of Killeavey homestead on Early Hill (mostly in **57^a**). The following significant sightings were made at Morrisons and the opposite section of Paddles on 22/23 January 1991.

- Red-capped Robin: breeding in the Black Wattles between the transmission line and Killeavey (14.6)
- White-winged Triller and Rufous Songlark: both calling from the Yellow Box at the end of Target Road on Paddles, opposite the southern peninsula (14.6)
- Speckled Warbler: breeding in a Silvertop Wallaby-grass tussock in the open, grassy woodland beside the track into Killeavey (14.6)
- Brush Bronzewing, Brush Cuckoo, Cicadabird and Red-browed Treecreeper: each by the river in Manna Gum/Burgan (5.1/5.2) on the southern peninsula.

De **57^e: High diversity of native fish in the Yarra at the Pound Bend Tunnel exit/Glynns.** Nine species were recorded in this section of the river. This is the next highest diversity recorded in NEM after Dights Falls. The section provides the most diverse habitat along the entire Yarra in combination with the most optimal habitat and water quality of the Middle or Lower Yarra. This is evidenced by low turbidity and probably high suspended oxygen levels. The riparian vegetation is unequivocally the best in the Lower/Middle Yarra, evidenced by the diversity of instream meadow (see grayling) and prey species observed in this section of the Yarra. Depletion of plant cover and competition from other bottom dwellers including European Carp are threats.

The fish diversity may also be due to the section being the upstream plateau for some of the migratory estuarine species. For the next 10 km, water in the Warrandyte Gorge runs fast and is unsuitable to some of these. Further upstream in the Yarra Glen to Healesville section of the Upper Yarra, water and riparian habitat quality are depressed. The combination of a series of highly intact rapids, banks and pools provides the overlap of feeding and breeding habitat for a high diversity of fish species.

Four species were recorded from an electrofishing and mesh-netting survey of the 250 m section of water upstream of the Pound Bend Tunnel exit on 22/23 July 1993 (Tarmo Raadik pers. comm.). These include one Short-headed Lamprey, the Short-finned Eel, 20 Macquarie Perch and 60 Australian Smelt. The Australian Grayling (see *Bb*) and a school of about 20 juvenile Common Galaxias were seen 400 m downstream at Glynns rapids on 28 December 1994. Murray Cod, Freshwater Blackfish and Tupong have been taken from pools in the section by local anglers in the last five years. The most recent record of the Murray Cod was a 35 cm individual taken in October 1996 from a deep pool downstream of Glynns rapids (Graeme Creed of Native Fish Australia pers. comm.).

The Murray Cod and Macquarie Perch were translocated into the Yarra from the Broken River in northern Victoria in 1938 and 1943. Both are listed as vulnerable in their native habitat. Populations in the Yarra are considered significant to the conservation of the species in a Victorian context. Like the Broad-shelled Tortoise and Murray River Tortoise, they are included as 'regionally rare native fauna' but not 'threatened fauna' in the Yarra. The Macquarie Perch is breeding and substantial juvenile populations are present. Murray Cod have also been taken downstream at Sweeneys Lane (**57^c**) in the last five years. The cod is apparently not breeding due to sub-optimal water temperature and will probably die out. Restocking with these species and Brown Trout should be discouraged as the Yarra supports significant populations of indigenous species.

Water and habitat quality of the section between Alexander Road and Pound Bend Tunnel is considered some of the finest in the Middle Yarra. With the installation of the fish-way at Dights Falls, additional migratory species may breed locally or would certainly move through the section to spawning areas in the catchment. These include the Pouched Lamprey, Broad-finned Galaxias, Spotted Galaxias and Tupong.

Df **57^d: High diversity of butterflies at Morrisons.** The southern section of Morrisons between Reynolds Road and the southern peninsula was systematically surveyed for butterflies. Survey visits were 18 October 1994, 2 December 1994, 21/22 December 1994, 7 January 1995, 22 February 1995, 13 April 1995 and 14 November 1995. The opposite side of the river at Paddles was visited on 27 January 1990. Altogether 33 species were recorded. Additional information for Morrisons was provided by Michael Braby. The site is the most downstream in the Yarra system supporting a high butterfly diversity. This is indicative of the extensive and intact stands of habitat present. Two eastern Victorian coastal species (Dingy Dart and Doubleday's Skipper) enter NEM along the Mullum Mullum Creek valley.

Several upland species were recorded including the Flame Skipper, Bank's Brown, Spotted Brown, Cyril's Brown and Bright Copper. These were not recorded (or have been likely eliminated from the paperbark swamps in the case of the Bank's Brown) from the Yarra Lowland Alluvial Plains downstream. They breed along the sheltered escarpments and floodplain of the Yarra and Laughing Waters Creek. There is potential habitat present for the vulnerable Genoveva Azure (Box Mistletoe in association with Sugar Ants on the mature Yellow Box) and Ictinus Blue (Black Wattle in association with Meat Ants). Further surveys for these species should be conducted.

Habitats surveyed include Manna Gum (riverbank) riparian forest (5.1; Yarra), Manna Gum (floodplain terrace) riparian forest (5.2; Yarra); Manna Gum (creek) gully woodland (10.1; LW Creek); Long-leaf Box escarpment woodland (13.1; LW Creek, southern peninsula and between Reynolds Road and transmission line); Yellow Box escarpment woodland (13.2; southern peninsula); Yellow Box–Candlebark grassy woodland (14.6; Reynolds Road/Killeavey driveway and homestead); Muttonwood riparian scrub (18.1; transmission line rapids); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2; transmission line cliffs).

Significant species

- Doubleday's Skipper: adults in flowering Burgan (13.2) at Morrisons southern peninsula on 2 December 1994 and flowering Prickly Tea-tree (10.1) on LW Creek on 1 January 1995; presumably breeding on Weeping Grass
- Donnyssa Skipper: adult feeding in flowering Burgan (10.1) along LW Creek at Morrisons on 2 December 1995
- Spotted Skipper: tubular shelters containing pupae in Thatch Saw-sedge (14.6) between LW Creek and the Killeavey driveway at Morrisons and the adjoining frontage of Reynolds Road; several fresh adults feeding in flowering Common Rice-flower (14.6) on 14 November 1995
- Flame Skipper: single adult near LW Creek at Morrisons feeding in flowering Burgan (14.6) on 2 December 1994 and flowering Prickly Tea-tree (10.1) and Sweet Bursaria (13.1) on 1 January 1995
- Bright Shield Skipper: adults feeding in flowering Sweet Bursaria (13.1) and Prickly Tea-tree (10.1) on 7 January 1995; breeding on Slender Tussock-grass on a sheltered bank of LW Creek (10.1)
- Phigalia Skipper: adults feeding in flowering Snow Daisy-bush on the southern peninsula river terrace (5.2) and southern cliffs (20.2) on 18 October 1994 and by the Killeavey driveway in flowering Common Rice-flower (14.6) on 14 November 1995
- Phigalioides Skipper: several adults feeding in flowering Burgan and Curved Rice-flower (14.6) near the Killeavey driveway at Morrisons on 2 December 1994 and adult feeding in flowering Sweet Bursaria (14.6) at same locality on 1 January 1995
- Symmomus Skipper: several adults seen on the sheltered escarpment (13.1) of LW Creek on 22 February 1995; pupal cases located on nearby Spiny-headed Mat-rush
- Dingy Dart: adult seen on 2 December 1994 feeding at ornamental shrubs in the house garden at Killeavey above the transmission line cliffs; several advanced larvae were located on 22 February 1995 in cylindrical shelters woven into basal stems of Blady Grass on the cliffs (20.2)
- Cyril's Brown: several adults hill-topping along southern peninsula on 18 October 1994
- Spotted Brown: two adults along LW Creek on 22 February 1995
- Bank's Brown: an advanced larvae located at the base of Slender Tussock-grass in a sheltered flat under Burgan, Prickly Tea-tree and Swamp Paperbark (5.2) on the river terrace opposite Reynolds Road on 27

January 1991; the tussock-grass was noticeably grazed; several adults flying in the sunny openings of LW Creek (10.1) on 13 April 1995

- Meadow Argus: adults in the grassland under the transmission line easement (formerly 14.6) in December/January 1994/95
- Blue Jewel: several adults flying amongst the 1962-fire regrowth Black Wattles (14.6) by Killeavey driveway on 22 December 1994
- Common Imperial Blue: the largest colony of adults, larvae and pupae seen in NEM (several thousand) in Silver Wattles (5.2) on the river terrace opposite Reynolds Road at Paddles on 27 January 1990; adults seen at Morrisons on most visits over December/January 1994/95 (small breeding colonies on Black Wattles, mainly in 14.6)
- Bright Copper: adult on the sheltered escarpment of LW Creek 7 January 1995; a pupal case and colony of the presumed attendant ant (*Iridomyrmex* sp. *nitidiceps* group) was located at the base of a nearby Sweet Bursaria
- Dark Purple Azure: seen on only one occasion (7 January 1995) flying around Creeping Mistletoe (larval food-plant) on a Long-leaf Box (14.6) by Killeavey track; the mistletoe is rare locally, being more common in Red Box or River Red Gum woodlands.

Fg 57^e: High population density of the Common Bent-wing Bat in Pound Bend Tunnel. A roost of 232 Common Bent-wing Bats and one Large-footed Myotis was located in Pound Bend Tunnel on 9 May 1989. Bats had been absent from the tunnel during a search on 10 March 1988 but on this occasion, 12 Common Bent-wing Bats were trapped at the downstream end of the tunnel. The Common Bent-wing Bat occasionally uses artificial nest boxes at Glynn's (Pat Fricker pers. comm.). The Large-footed Myotis feeds and roosts in association with permanent water in NEM. The tunnel completely fills when the river is in high flood.

How frequently roosting bats use the tunnel is unknown, but the number found in May 1988 indicates it is very important at certain times of the year. Bats may temporarily use the tunnel when other roosts in mines around Warrandyte are disturbed by humans. The bent-wing bat is known to forage over riparian forest and disperse along riparian corridors between roosts. Enhancing the width of the streamway link along Watsons Creek between the Yarra and One Tree Hill, where there is a large permanent roost, would benefit the species.

Other Significant Fauna

Birds

Cb 57^e: Waterbird survey at Pettys Wetland in February 1991. The wetland is an old orchard dam of about 1 ha and average depth of 1 to 1.5 m. It contains an island (waterbird night roost), mudflats (wader habitat), submerged meadows (waterfowl habitat) and fringing emergent herbfield (cover-dependent crane, rail and snipe habitat). Revegetation works including the establishment of fringing shrublands of Swamp Paperbark have been undertaken. Natural revegetation of waterplants has also occurred. Seasonal wetland areas are composed of emergent herbfield (25.7; notably Tall Spike-sedge and Common Spike-sedge) and mudflats while floating/submerged herbfield (26.1) is developing in permanent water.

Twenty-one waterbird species were recorded at Pettys Wetland from a 30-minute count on 5 February 1991. These included 68 waterfowl of 11 species including the Hoary-headed Grebe, Australasian Shoveler, Australian Shelduck and Musk Duck. The sedgeland fringes at the south end supported the Lewin's Rail (breeding) and Latham's Snipe (2). A Nankeen Night Heron was roosting in the paperbarks and an Australian Spotted Crake was seen at the edge of reeds on the island. A nest containing two eggs of the Black-fronted Dotterel was located on the high water mark of the shoreline.

Latham's Snipe visit the wetland in late spring-early summer. The submerged herbfield attracts waterfowl. A stand of Swamp Paperbark has been established at the southern end. A Nankeen Night Heron was roosting in the scrub and the Lewin's Rail was breeding amongst Knob Sedge and Common Spike-sedge adjacent to the scrub in February 1991.

Cb 57^e: Waterbird survey at Glynn's Wetland in November 1994. A series of permanent and seasonal wetlands was excavated along the river terrace over the summer of 1988/89. This stretches almost 1.5 km and

covers over 3 ha. The maximum depth of the main wetland is 2 m, while the average depth is about 1 m. A series of seasonal lagoons occur to the north-east of the main wetland. 15 000 plants had been established by winter 1993 (Pat Fricker pers. comm.). Natural revegetation of waterplants has also occurred. Seasonal wetland areas are composed of emergent herbfield (25.7; notably Tall Spike-sedge) while floating/submerged herbfield (26.1) is developing in the permanent water. As the vegetation develops, additional species and populations of waterbirds will visit the wetland.

Twenty-three waterbird species were recorded at Glynn's Wetland from a 60-minute count on 29 November 1994. These included 28 cormorants (3 Great, 20 Little Black, 4 Little Pied and 1 Darter) and 47 waterfowl of nine species including one Australian Shelduck and a pair of Chestnut Teal. A Brown Quail, Buff-banded Rail, Australian Spotted Crake (breeding) and two Latham's Snipe were flushed from rank grassland surrounding the seasonal wetland north-east of the main wetland. A Great Egret was observed in the shallows of the main wetland while two juvenile Nankeen Night Herons were roosting in the plantation scrub.

- Eb* **57^e: Little Friarbird.** Three were seen in flowering Manna Gum riparian forest (5.1) on the riverbank near the Pound Bend Tunnel exit on 8 March 1988. Two Yellow-tufted Honeyeaters (*Ec*) were also present. Both species, like the Regent Honeyeater, have become very rare in NEM over the last decade. The Little Friarbird is a rare and irregular migrant to southern Victoria from northern Australia. An influx occurred into NEM in summer 1987/88.
- Ec* **57^c: Black-tailed Native-hen.** Single bird seen under Manna Gum riparian forest (5.1) on the riverbank at Sweeneys on 7 June 1994 (Pat Fricker pers. comm.). This species is very rare in NEM. Vagrants appear every few years while small irruptions occur on eight to ten year cycles due to drought or post-breeding dispersal following wet years in the inland (see sites 38 and 40).
- Ec* **57^c: Black-winged Stilt at Pettys Wetland.** One to two Black-winged Stilts were present over December/January 1986/87 (Paul Peake pers. comm.). This species is seldom observed in the Middle Yarra.
- Ec* **57^b: Fuscous Honeyeater at Longridge rapids.** This species was recorded in Swamp Gum gully woodland (10.3) along a gully running into the Yarra at Longridge rapids on 26 July 1995. A small party of five birds, associating with White-naped Honeyeaters, fed in the canopy of the flowering Swamp Gums. The Fuscous Honeyeater is a rare winter visitor from northern Victoria in years of heavy local nectar flows of Red Ironbark, Yellow Gum and Swamp Gum.
- Ed* **57^{ce}: Australian Spotted Crake.** Recorded at Pettys Wetland on 5 February 1991 and breeding at Glynn's Wetland on 29 November 1994. The crake at Glynn's was flushed from a saucer-nest of grass located under a tussock on the upper terrace, about 20 m above the seasonal wetland north-east of the main wetland. The nest contained five eggs. The narrow muddy shorelines and beds of Cumbungi-Tall Spike-sedge seasonal wetland (25.7) at Pettys are ideal for the species. The bird spent time sunning in the open on the bank of the island. It was later seen wading during the day in the shallows, probing for mudflat invertebrates, probably crustacea, molluscs and insect larvae.
- Ee* **57^{ce}: Buff-banded Rail.** Two sightings. One in rank pasture fringing the north-east section of Glynn's Wetland on 29 November 1994. Another in similar habitat at Sweeneys Flats in July 1992 (Glen Jameson pers. comm.). This species at times utilises rank, damp pasture.
- Ee* **57^b: Peregrine Falcon, Leaden Flycatcher and Bassian Thrush.** A pair of falcons bred in a stick-nest in Manna Gum riparian forest (5.1) by the river near Longridge rapids in November 1994. A courting pair had been observed in the area in April 1994 (Glen Jameson pers. comm.). The flycatchers were breeding on the exposed escarpment of the Mappin block (adjacent to Longridge rapids) on 11 November 1994. A cup nest had been built in the fork of a eucalypt branch in Red Box escarpment woodland (13.3). The thrush (along with the Olive Whistler) was recorded in the undergrowth of Narrow-leaf Peppermint herb-rich foothill forest (6.2) on the sheltered escarpment of the Williams block (adjacent to Longridge rapids) on 26 July 1995. Both are uncommon winter visitors to Yarra Valley Park from upland areas.
- Ef* **57^{bcd}: Nankeen Night Heron.** Juveniles are frequently seen by the river and at floodplain wetlands between Mullum Mullum Creek and Pound Bend. They appear to be reared locally, but a breeding colony has yet to be located.

Mountain forest avifauna—Yarra River to Kinglake forest habitat link. Watsons Creek to the Yarra River links populations of a number of mountain forest species. The Manna Gum riparian forest supports gully species such as the Eastern Whipbird and Red-browed Treecreeper, which are now scarce due to a combination of habitat clearing and fragmentation. The whipbird is preyed upon by cats and foxes. These species at Morrisons, Birrarung and Glynns are particularly vulnerable as the area is on the end of a series of fragmented or linear links to larger and more secure areas in Kinglake NP. Local populations are dependent on uninterrupted faunal exchange between these areas.

Paddles—Mullum Mullum habitat link. Mullum Mullum Creek is important for the local movements of avifauna and is a component of the Strategic Habitat Link of the site. It is also the only effective southern link remaining in the Lower Yarra and assists the dispersal of birds (including the Regent Honeyeater) across the suburbs between the Yarra and Dandenong Creek. The enhancement of the link may be crucial for many of the forest species present in the upper Mullum Mullum (e.g. Red-browed Treecreeper).

Mammals

Ed **57^d: Gould's Long-eared Bat.** A male was trapped under Manna Gum gully woodland (10.1) along Laughing Waters Creek near Reynolds Road at Morrisons on 22 January 1991. Most trappings in GM during the field survey were from between 150 and 600 m elevation in the ranges and upland hills. Morrisons at 40 m is the lowest altitude at which it was trapped. The presence of species such as Mountain Grey Gum at Morrisons are indicators of a mountain biotic element in this section of the Yarra. The wet gullies contain small populations of these species.

In the survey of Greater Melbourne there were six or seven captures of the Gould's Long-eared Bat in the lowland hills and plains. Each was between late January and late March. It is possible that the bat undertakes late summer dispersal from the ranges into the lowlands. If this is the case, it underlines the importance of the Yarra to Kinglake corridor along Watsons Creek. The bat and the Mountain Grey Gum make one of their nearest known approaches to the metropolitan area at Morrisons.

Ee **57^{bcd}: Platypus.** Single animals were seen at Morrisons transmission line rapids on 27 January 1990 and 22 January 1991, Glynns rapids on 29 November 1994 and Longridge rapids on 30 November 1994. The habitat at the three sites is Muttonwood riparian scrub (18.1). Three animals were recorded in Manna Gum (creek) riparian forest (5.3) during a dusk survey of lower Mullum Mullum Creek on 16 January 1995. The Platypus is uncommon in the Yarra and populations have declined over the last two decades (Virginia Morrison pers. comm.).

Platypus have been recorded mainly at rapids and tributary confluences in the Yarra. The most productive feeding areas occur near rapids. These include gravel riffles to upstream, instream meadows in backwaters of rock-bars and islands and sandy bays to downstream. The main prey of Platypus include small crustaceans and frogs, worms and aquatic insects such as mud-eyes (dragonfly larvae) and caddis flies. Banks of the lower reaches of tributaries provide the preferred breeding habitat (rather than riverbanks of the Yarra). See also Watsons Creek to Christmas Hills site and site 35.

Despite being mildly polluted from urban runoff, the lower Mullum Mullum was found to be the most productive local area in the Yarra Platypus Watches of 1995/96. This is because the section is contained in Yarra Valley Park, where it is protected from adjacent residential development and disturbance. It is also due to the proximity of cleaner water in the Yarra. The lower reaches of all other major tributaries of the Yarra in NEM (with the exception of Watsons Creek) are residential.

Ef **57^{bcd}: Water Rat.** Single animals were seen at Morrisons transmission line rapids on 22 January 1991 and Longridge rapids on 4 December 1987 and 30 November 1994. The habitat at both sites is Muttonwood riparian scrub (18.1). Water Rats were also seen at Pettys Dam on 5 February 1991 and Glynns Wetland on 29 November 1994. Prey middens of mussel shells and crustacean carapaces and claws were frequently encountered on rock platforms at rapids. Water Rats are more common and widespread than Platypus in the Lower and Middle Yarra. The combined effects of inadequate water quality, habitat alteration and bank disturbance may lead to a population decline, as has occurred for the Platypus.

Ef **57^{bde}: Koala.** A road-killed Koala was recorded on the Heidelberg–Warrandyte Road near Crystal Brook caravan park on 27 January 1991. Another was seen in the same area in June 1993 (Glen Jameson pers. comm.). The Koala had become locally extinct and was reintroduced in 1985. One to two animals were seen during the study in Manna Gum riparian forest (5.1/5.2) along the river at Morrisons, McCullaghs and Glynns. The species (males in particular) disperses along contiguous riparian forest links. The Yarra Valley population is expanding and it would now appear that there may be insufficient seasonal forage trees along the river. This forces individuals to become mobile but they are unable to disperse safely to the south of the river. Major roads bottleneck the movement of most forest fauna species, but severely affect the dispersal of large mammals. Attacks from dogs are also likely.

Revegetation throughout the river section of the Yarra Valley Park will increase the area of suitable habitat for the Koala. This will be needed to counteract the loss of habitat and severance of external links as urban areas develop to the north of the river between Research and North Warrandyte. As the Mullum Mullum habitat link develops through revegetation at Paddles, provision for dispersal of species such as Koalas through a tunnel under the Heidelberg–Warrandyte Road might be considered.

57^b: Brown Antechinus. One was trapped in Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slope to the west of Birrarung in Laughing Waters Road on 4 April 1987. Scats of the antechinus were also recorded in nest boxes during a study undertaken by Biosis Research nearby on the McCullagh block in 1990 (Larwill *et al.* 1991). The antechinus is known to survive downstream at the mouth of Diamond Creek, but is locally threatened by habitat fragmentation caused by clearing, removal of ground log shelter for firewood and depletion of native plant cover/invertebrate prey by stock grazing. Predation from foxes and probably cats may also be a significant threatening process. Antechinus remains have been recorded in fox scats on the McCullagh block (Larwill *et al.* 1991).

Reptiles

Ed **57^b: Eastern Small-eyed Snake.** One was located under a log on a stony escarpment under Red Box escarpment woodland (13.3) at McCullaghs on 22 January 1991.

Ed **57^c: Broad-shelled Tortoise at Pettys Wetland.** The wetland was fyke-netted on 5 February 1991 and was found to support a large population of Common Long-necked Tortoises (17 taken). A Broad-shelled Tortoise was seen sunning at the edge of the wetland. This species is native to the Murray River and has been introduced into the Yarra. There are reports of the Murray River (short-necked) Tortoise also at Pettys. This species has been confirmed at Westerfolds Park.

57^d: Reptiles of Morrisons/Paddles. Seven species including the Tree Dragon, White's Skink, Weasel Skink, Southern Water Skink, Blotched Blue-tongued Lizard and White-lipped Snake were recorded at Morrisons on 22 January 1991. The White-lipped Snake and White's Skink were seen amongst a senescent (1962 fire-regrowth) stand of Black Wattle where abundant fallen debris was present (Long-leaf Box escarpment woodland; 13.1). Weasel Skinks were common in this area and would comprise an important prey component of the snake. Southern Water Skinks were present in riparian forest (5.1/5.2) along the Yarra and Tree Dragons were located amongst fallen timber in open, grassy sections under Yellow Box–Red Stringybark box–stringybark woodland (11.2) and Yellow Box–Candlebark grassy woodland (14.6). The Delicate Skink and Eastern Three-lined Skink were recorded in the latter habitat amongst dense Kangaroo Grass at Paddles on 27 January 1991.

Freshwater fish

Ec **57^e: Short-headed Lamprey.** A juvenile 105 mm long (downstream migrant) was taken in a mesh-netting survey upstream of the Pound Bend Tunnel exit on 22/23 July 1993 (Tarmo Raadik pers. comm.). Their life-cycle and body morphology/behaviour has several different stages. They spawn in spring in the middle and upper reaches of coastal streams. Small numbers would likely breed in the Middle Yarra but they are locally common in the Upper Yarra (John Koehn pers. comm.). The eggs are laid in a mud depression in shallow, running water and covered with sand, pebbles or gravel (Koehn & O'Connor 1990).

During early development, lamprey are eyeless and toothless, worm-shaped larvae (ammocetes) living a sedentary existence. They burrow in mud under shallow, gentle-flow areas of streams and filter feed microscopic

organisms such as algae and detritus taken from the surface of the mud. Usually in autumn, about 3.5 years after hatching, ammocoetes metamorphose into juvenile 'eyed' stages (macrophthalmia). These are more elongate and compressed with fins to enable rapid swimming. The metamorphosis takes six months after which they move downstream to coastal estuaries and then out to sea for a further 18 months. The macrophthalmia are parasitic and jawless, possessing suction disks lined with horny teeth that rasp away the flesh of marine fish.

The macrophthalmia transform into pre-reproductive adults (velasia) and return to freshwater to spawn at about six years of age. Migration peaks during spring, mainly at night, while during the day they burrow into the mud under brisk-flowing water. The oral disks enable them to climb damp vertical surfaces such as weirs. In moist conditions they are known to move overland to by-pass instream obstructions. The velasia are unable to feed on their return to freshwater and by the time of spawning (several months later) the adults are fully spent and soon die.

Ec **57^e: Tupong.** One about 14 cm long was taken by an angler from a pool downstream of Glynn's rapids in December/January 1993/94 (Graeme Creed of Native Fish Australia pers. comm.). This was possibly juvenile to young adult in age.

Tupong are small to medium size fish (normally 15–20 cm and occasionally as fully mature adults to over 30 cm). Tupong are slender and cylindrical with a flattened head and dorsally placed eyes. Fins are angular with large pectorals adapted to a bottom-dwelling existence. Male Tupong occur only in the estuarine environment. Females occur in the estuary and Lower and Middle Yarra. In rivers such as the Yarra they inhabit slow-flowing water, usually with substrates of sand or silt and logs or boulders.

Females migrate between freshwater and seawater and move downstream during high stream flows in winter to breed in spring in river estuaries. Fry develop in the estuaries for nine months or more, females returning upstream in a gradual movement as stream flows abate in late spring and summer. Apparently only small numbers occur in the Yarra River below Dights Falls though populations appear to vary seasonally and annually (Tarmo Raadik pers. comm.). The weir at Dights Falls apparently blocked their upstream migration as they are poor swimmers. With construction of a fish-way in 1993, they have resumed their former migration pattern in the Yarra. Potential adult non-breeding habitat has become available, particularly in the Middle Yarra between Templestowe and Warrandyte. Populations in the system appear to be increasing.

Tupong inhabit quiet water in shallower pools and slow riffles protected behind rock-bars and islands. The feeding behaviour of Tupong is to lie motionless, often partly buried in muddy or sandy substrates in waiting for prey, occasionally making rapid pursuits after them along the floor (Koehn & O'Connor 1990). Their diet is varied, mainly of substrate invertebrates such as insect larvae (principal dietary component in streams), crustacea (principal dietary component in estuaries), small fish, worms and probably some plant material.

57^c: Pettys Wetland. The Short-finned Eel and Southern Pigmy Perch were fyke-netted at Pettys Wetland on 5 February 1991 (Steve Saddler pers. comm.). The pigmy perch and Freshwater Blackfish were stocked in 1989. The blackfish appear to have been removed by illegal drum-netting (Pat Fricker pers. comm.). The pigmy perch are surviving but the wetland does not yet provide adequate submerged vegetation and fringing scrub for them to do well.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link downstream to the Lower Eltham Park–Thomsons site and upstream to the Pound Bend–Fourth Hill–The Common–Black Flat site in Warrandyte SP. Partially intact link north overland to the Stony Creek–Pigeon Bank–Laughing Waters Creek site. The site is the most important as a biological reserve and habitat link in Yarra Valley Park. The Yarra forms the most important wildlife corridor in GM. The areas of highest faunal diversity contain the most diverse, intact and extensive habitat assemblages (e.g. Morrisons). The site is the gateway from the hills to the alluvial plains in the Yarra–Kinglake habitat link. It is also critical to the Mullum Mullum Creek habitat link which is the most important and effective southern link remaining in the Lower and Middle Yarra.</p>	
<p>Habitat loss and fragmentation due to urban growth. Perimeter fragmentation of the most intact blocks such as Morrisons can be directly equated to loss of biological values within the interior of the blocks. For example, elevated populations of Bell Miners and Noisy Miners caused by fragmentation have lowered habitat utility for the Regent Honeyeater. Likewise, an increased level of rabbits has affected orchid populations.</p> <p>Bell and Noisy Miners and eucalyptus dieback. Both miner species have substantially increased in numbers and expanded in range. This is in response to fragmentation of forest habitat due to clearing and removal of understorey vegetation by livestock grazing and burning and recent urban encroachment. Concomitant with this increase has been a decline in foliage canopy insectivore species (e.g. pardalotes). Both species of miners competitively exclude these beneficial birds (control agents of defoliating insect) and contribute to the dieback of Swamp Gums and Narrow-leaf Peppermints in sections of the floodplain and in valleys and gullies. There are severe outbreaks caused by the combined effects of both species at Sweeneys and Paddles (particularly along the lower Mullum Mullum) and Bell Miners in the valleys and gullies on Morrisons and Birrarung. The valleys of Swamp Gum and Yellow Box over dense stands of Burgan (regrowth from fires and clearing) and Blackberry at Morrisons provide optimal habitat for Bell Miners.</p>	<p>Strengthen Strategic Habitat Link. This is the most significant site and strategic habitat link in the Yarra Valley Park and should be managed primarily for the conservation of flora and fauna and habitat link utility.</p> <p>Revegetation to ameliorate tree dieback induced by Bell and Noisy Miners. Despite extensive revegetation of cleared areas along the floodplain, the preconditions which favour the miners are only slowly reversing. Bell Miners benefit from the establishment of narrow plantation strips or small revegetation plots with a high edge to interior habitat ratio. Grassy woodland insectivore census studies determined that forest-edge species normally occupy a strip about 50 m wide. The south side Yarra frontage riparian forest in the park does not exceed this width at any point and the streamway acts in effect as an ‘edge’ as well as a corridor.</p> <p>The ratio of interior to edge habitat of the strips must exceed 1 to 1 for most foliage insectivores to successfully coexist with miners, and maintain control over dieback. If it is less, fewer beneficial species and populations will be present, and the dominance remains with the miners (see Volume 1).</p>

 Regional Hydrological Strategy

Declining water quality of the Yarra. Past farming and urban land-uses upstream have led to stabilising native vegetation along the river being replaced by White Crack Willow and Blackberry. This has caused severe bank erosion. As willows grow out into the water they become undermined by the current and slump into the river, taking the banks with them. This disrupts the flow, leading to siltation. Islands at rapids fragment into series of channels. Perennial herbs and substrate are scoured away during floods. Silt from eroding surfaces dumped into the sandy bays downstream of rapids has smothered the instream herbfields. These are being further eliminated by European Carp.

Long-term improvement in water quality of the Yarra and its tributaries required.

Populations of the Platypus and Freshwater Blackfish are at the cross-roads in the Lower Yarra. Both may become locally extinct if water quality does not improve. The water quality of tributaries which rise in urban catchments is poor. Mullum Mullum Creek, however, still supports a substantial population of Platypus (see Fauna: mammals *Ee*). Improving the water quality of the tributaries will require a radical change in council, government and community attitudes. Urban runoff must be retarded and settled before it enters the system.

Streamway management. The primary objective of management should be to enhance the habitat link for the movement of wildlife and improve the quality of habitat for its resident species. This would be achieved through protecting existing habitat and restoring degraded habitat including repairing riverbanks. The sections of highest significance (Morrison, Mappins and Glynn) should receive the greatest effort.

The gradual replacement of willows with indigenous riparian species should continue. The appropriate procedure to follow is discussed in site 50.

The severity of the natural river dynamics, combined with the elevated nutrient, siltation and disturbance regimes, has led to a degradation cycle. This is only slowly reversible through substantial conservation works.

Native fish are present including several threatened species including the Freshwater Blackfish and Australian Grayling. With improved conditions, the migratory grayling will almost certainly breed (if not already) in the rapids between Mullum Mullum Creek and Pound Bend. Stocking the river with trout and river 'improvement' works such as desnagging (removing submerged logs used by fish for shelter and spawning) must be discontinued.

Wetland development and enhancement. The wetlands at Pettys and Glynn have become important for waterbirds and should continue to be developed to attract and maintain a greater diversity of species. The successful establishment of native fish at the wetlands should be a priority. The Southern Pigmy Perch at Pettys have been slow as the wetland has not yet developed extensive submerged herbfields and has insufficient shrub and tree cover at the waters' edge. Submerged logs and fringing shrub vegetation provide food and shelter. Pigmy perch often spawn amongst the submerged roots of shrubs and trees. Planting 500 or more Swamp Paperbark near the water would provide adequate spawning areas as well as screens for waterbirds and habitat for reptiles and frogs.

Excessive human disturbance will restrict full utilisation of wetlands such as Pettys by waterbirds (e.g. Australian Shelduck), particularly for nesting purposes. The wetlands in the site are relatively small and, while supporting a diverse waterbird assemblage, fail to support large populations of waterbirds. They support only small areas of submerged herbfield and relatively low populations of frogs, marshland passerines (e.g. Little Grassbird and Golden-headed Cisticola) and Latham's Snipe. Pettys Wetland would become a more significant waterbird area if it were increased in size and diversity, particularly in areas of seasonally flooded herbfield and scrub (akin to the original wetlands of the Lower Yarra).

Other Issues

<p>Recreation and disturbance effects.</p> <p>Predation of native fauna by feral and domestic carnivores.</p>	<p>Fauna plan of management. A plan for the Yarra Valley Park was outlined by Larwill <i>et al.</i> 1991. It proposed the section of the site including Morrisons, Birrarung, McCullaghs and Glynn's as a conservation zone. The section including Pettys and Sweeney's is proposed as a habitat enhancement zone. Limited or controlled public access conditions are recommended for both zones. These findings are endorsed by this study. A summary of broad management issues includes:</p>
	<ul style="list-style-type: none"> •Referral authority for urban growth. Melbourne Parks and Waterways should be the referral authority for planning permits adjacent to the park boundary. •Fire management. An ecologically based fire management plan is needed.
	<ul style="list-style-type: none"> •Public education on adjacent land-use management. Controls such as restrictions on timber removal should be brought into operation. Government agencies and councils should assist landowners with revegetation. They should provide education material relating to the importance of their land in maintaining wildlife populations in the Lower Yarra and the improvement of the natural quality of the urban environment. A study on managing significant vegetation of roadside and transmission line easements is necessary. •Yarra River trail and livestock agistment. The proposal for extending the trail through significant habitat areas upstream of the Mullum Mullum should be reviewed and resited to areas of minimum impact to flora and fauna values. Livestock grazing/agistment at Paddles should be phased out to enable the commencement of a full revegetation program.

Conservation Measures for Glynns Environmental Education Centre and Pettys
Wetland bird hide

Establishment/maintenance of controlled public access upstream of the Mullum Mullum. The rate of illegal entry of motorbike, mountain bike and horse riders, shooters, campers and timber poachers must be reduced.

Boundary fencing. Fences should provide for the movement of native fauna (e.g. Wombat gates and canopy connections for arboreal species such as Koalas). Strategic breaks in the fencing should permit the movement of macropods but deter the movement of dogs.

Dog control and responsible pet ownership regulations. The entry of dogs is prohibited in all sections of the park occurring in the site. To encourage waterbird visitation and breeding, dogs should be excluded from the surrounds of all wetland areas in the Yarra Valley Park. They should not be permitted on the proposed Yarra Trail in Yarra Valley Park. It is vital that an intensive responsible pet ownership program is targeted for residents adjacent to the park. Councils should consider introducing owner conditions which decrease the rate of park incursions by domestic animals (particularly dogs and cats) in these areas (see Volume 1).

Feral animal control. Species in need of address include the rabbit, hare, fox, cat, goat, Common Myna, Common Starling and Common Blackbird. Mynas are particularly aggressive toward parrots while nesting, and on several occasions have been observed ejecting adults and killing fledglings.

Native animal monitoring/control. The grazing effects of the Eastern Grey Kangaroo and Common Brushtail Possum should be monitored. Future populations may need regulating if numbers increase to levels where they have deleterious and otherwise irreconcilable impacts on native vegetation. Levels of Bell Miner and Noisy Miner populations should be monitored with regard to eucalyptus dieback.

Weed control. Areas of most significant native vegetation (e.g. Morrisons) should continue to be a high priority for weed control management. It is important for species such as the Eastern Whipbird that the control of Blackberry, and possibly Burgan, be accompanied by plantings of suitable replacement shrubs.

Revegetation and habitat rehabilitation. The excellent program under way in downstream sections of the Yarra Valley Park should be continued and expanded, particularly in the Paddles/Mullum Mullum creek area. In 1990 some 50 000 trees and shrubs were planted in Yarra Valley Park. With the exclusion of livestock grazing, substantial sections, particularly hill-slope areas such as McCullaghs and Glynns, have undergone natural regeneration. Revegetation plans including adequate provision of native field layer species will need to be devised.

Artificial nest box program. The program for Glynns and McCullaghs commenced in 1982. This has been very successful as about 10 native mammal species including the rare Brush-tailed Phascogale and Common Bent-wing Bat have been recorded using the nest boxes.

Establishment of the Friends of Yarra Valley Park group. The area contains a broad cross-section of community conservation groups. Considerable support has been enlisted, including the services of volunteer groups such as the ATCV, the friends group formed in 1991 to assist with labour intensive works such as tree planting and weed removal.

Implementation of Native Vegetation Clearance Controls on private land. Relating to bushland adjacent to the park in the Gumtree Road and Reynolds Road areas.

Planning Recommendations

Yarra—Yellow Box Woodlands Ecological Reference Area (ERA). The proposed ERA contains the Yarra River from Reynolds Road to upstream of Morrisons upper rapids and includes most of Morrisons (Killeavey) and the property fronting the river to the east along Laughing Waters Road.

The ERA requires restricted public access conditions apart from research, nature interpretation and management activities. It also requires nature conservation of all native habitat and potential native habitat to be the principal planning/land-use priorities. The ERA encompasses land in the Yarra Valley Park and contains specific conservation

and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). The ERA lacks a public land buffer zone along its northern frontage (Laughing Waters Road). The negotiation of conservation covenants or similar conservation agreements as to the management of this adjacent freehold bushland would be desirable.

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the ERA include:

- Yellow Box–Red Stringybark box–stringybark woodland (11.2): orchid assemblage.
- Long-leaf Box–Manna Gum and Yellow Box escarpment woodlands (13.1/13.2): rare orchids and Clover Glycine.
- Yellow Box–Candlebark grassy woodland (14.6): Barking Owl and prey assemblages (including the Sugar Glider), lorikeet assemblage, Swift Parrot, migratory insectivores, Clover Glycine and Slender Tick-trefoil.
- Manna Gum/Swamp Gum gully woodlands (10.1/10.3)—Laughing Waters Creek and gullies: insectivorous birds; and Yellow Box–Candlebark valley forest (31.1).
- Manna Gum riparian forest (5.1/5.2), Muttonwood riparian scrub (18.1) and Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2)—river banks, rapids and cliffs: migratory insectivores, Grey Goshawk, Regent Honeyeater, Koala, Platypus, the Leafy Greenhood and cliff face vegetation.

Site 58 Pound Bend–Fourth Hill–The Common–Black Flat

- Map Reference:** 7922 413223 to 7922 449218 (Yarra River from 900 m upstream of the Pound Bend Tunnel exit to Jumping Creek). One minute lat/long grids include 37° 43' x 145° 12' to 145° 13', 37° 44' x 145° 12' to 145° 14' and 37° 45' x 145° 12' to 145° 14'.
- Location/Size:** Warrandyte SP and Yarra River at Warrandyte from Pound Bend (excluding the tunnel) to Jumping Creek. Approximately 550 ha.
- Municipality:** Shire of Nillumbik and City of Manningham.
- Land Tenure/Use:** Public: NRE (Warrandyte State Park—fragmented blocks including Pound Bend, Andersons Creek Reserve, Fourth Hill, Whipstick Gully, Fifth Hill, Timber Reserve, Black Flat, The Island and The Common; and Crown Allotment 3A, the Youth Hostel Association land at Pound Bend); Shire of Nillumbik (Norman Reserve); City of Manningham (Stiggants Reserve and Warrandyte Township River Frontage; under Committee of Management). Private: adjoining bushblocks zoned Landscape Interest and residential areas. Warrandyte SP is 586 ha, about 320 ha of which occurs in this site.
- Landforms:** Foothill (see YLH B). Elevation is 27–138 m (Fifth Hill).

Natural Heritage Values

Landscape. The mines of Warrandyte are of historical significance. The Yarra upstream of Warrandyte has been proposed a Natural Heritage River. Warrandyte SP contains lowland habitats which are poorly represented in the biological reserve system of southern Victoria.

Scientific and Educational Values

Rehabilitation and management. Habitat restoration, revegetation, rare plant protection and weed eradication programs are high priority in the park. These need to be continued and adequately resourced. Friends of the Warrandyte SP.

Public interpretation. Ranger/Friends of the Warrandyte SP activities. Estimated annual visitor rates to the SP are 300 000 (DCE 1990b).

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: Manna Gum gully woodland (10.1; Jumping Creek)

Relatively intact and extensive stands: Manna Gum (riverbank) riparian forest (5.1); Manna Gum (floodplain terrace) riparian forest (5.2); Red Box escarpment woodland (13.3); Muttonwood riparian scrub (18.1); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2)

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Narrow-leaf Peppermint herb-rich foothill forest (6.2); Messmate–Swamp Gum gully woodland (10.2); Swamp Gum gully woodland (10.3); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark valley forest (31.1); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5)

Vulnerable species: Spotted Duckweed, Wine-lip Spider-orchid

Rare species: Stream Club-sedge, Caladenia (*Caladenia* aff. *prolata*), Bearded Greenhood, Billy-buttons (*Craspedia* sp. *nova*)

Critical assemblages or populations: Strategic Habitat Link. Orchid flora of Fourth/Fifth Hill and Timber Reserve

Notable features: Johnsons Mine and Victory Mine: small roosting colonies of cave-bats

FAUNAL SIGNIFICANCE: Site 58 Pound Bend–Fourth Hill–The Common–Black Flat

Assessment: Regional—Category 1 (B, C, D, E, F)

58^a: 37° 44' x 145° 12'; Warrandyte SP–Pound Bend/Betton Track

58^b: 37° 44' x 145° 13'; Warrandyte SP–4th Hill/Whipstick Gully/Timber Res/Island

58^c: 37° 44' x 145° 14'; Warrandyte SP–Black Flat/The Common/upper Jumping Creek

58^d: 37° 45' x 145° 13'; Warrandyte SP–Andersons Creek/5th Hill/Fiddler Gully

A. Cited Zoological Significance

State. Yarra River and Little Yarra River site: Mansergh *et al.* (1989)

Regional. Warrandyte State Park site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 58^c: Swift Parrot (Black Flat in March 1988)

c. Rare fauna

Regional. 58^d: Powerful Owl, Large-footed Myotis, Common Bent-wing Bat

Regional. 58^a: Powerful Owl (breeding), Freshwater Blackfish

Regional. 58^b: Powerful Owl, Common Bent-wing Bat

Regional. 58^c: Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 58^a: 5 species at Pound Bend on 7 March 1988

Regional. 58^b: 4 species at the Timber Reserve on 10 March 1988

Regional. 58^c: 4 species at Black Flat on 9 March 1988

m. Freshwater fish

Regional. 58^a: Freshwater Blackfish and Short-finned Eel electrofished from Yarra at Forbes Street on 3 November 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 58^a: 93 species. **58^b**: 89 species. **58^c**: 87 species

b. Native birds

Regional. 58^a: 73 species. **58^c**: 69 species. **58^b**: 69 species

c. Native mammals

Regional. 58^c: 13 species. **58^b**: 10 species. **58^a**: 9 species

d. Herpetofauna

Regional. 58^b: 10 species

Local. 58^a: 6 species. **58^c**: 5 species

e. Freshwater fish

Regional. 58^a: 5 species (*Cm* plus Australian Smelt, Macquarie Perch and Murray Cod)

f. Butterflies

Regional. 58^b: 23 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 58^b: 8 species. **58^{ac}:** 7 species

c. Regionally vulnerable fauna (R2 species)

Regional. 58^a: 2 species. **Fish:** Australian Smelt, Freshwater Blackfish

Regional. 58^b: 2 species. **Mammals:** Common Bent-wing Bat. **Butterflies:** Bright Copper

Regional. 58^c: 2 species. **Mammals:** Brush-tailed Phascogale, Common Bent-wing Bat

Regional. 58^d: 1 species. **Mammals:** Large-footed Myotis

d. Regionally rare fauna (R3 species)

Regional. 58^a: 3 species. **Birds:** Pink Robin. **Fish:** Murray Cod, Macquarie Perch

Regional. 58^b: 3 species. **Birds:** Collared Sparrowhawk, Pink Robin, Spotted Quail-thrush

Regional. 58^c: 1 species. **Mammals:** Feathertail Glider

Regional. 58^d: 1 species. **Reptiles:** Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

Regional. 58^b: 4 species. **Birds:** Powerful Owl, Bassian Thrush, Speckled Warbler. **Butterflies:** Blue Jewel

Regional. 58^c: 4 species. **Birds:** Peregrine Falcon, Swift Parrot, Bassian Thrush. **Reptiles:** Red-bellied Black Snake

Regional. 58^a: 2 species. **Birds:** Powerful Owl, Eastern Whipbird

Regional. 58^d: 2 species. **Birds:** Powerful Owl, Leaden Flycatcher

f. Regionally restricted fauna (R5 species)

Regional. 58^b: 10 species. **Birds:** Brush Bronzewing, Rainbow Lorikeet, Rose Robin, White-winged Chough. **Mammals:** Koala. **Frogs:** Southern Toadlet. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus

Regional. 58^a: 9 species. **Birds:** Barn Owl, Brush Bronzewing, Nankeen Night Heron, Rainbow Lorikeet, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink

Local. 58^c: 3 species. **Birds:** Nankeen Night Heron, White-winged Chough. **Mammals:** Water Rat

Local. 58^d: 1 species. **Birds:** Little Eagle

g. Nesting birds of prey/parrots

Regional. 58^a: Powerful Owl near Norman Reserve from 1991-93

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

Regional. 58^c: Common Bent-wing Bat droppings in a mine shaft at Parsons Gully (private property off Nelson Drive south of Black Flat)

Regional. 58^b: Common Bent-wing Bat at Victory Mine and Johnsons Mine

h. Other fauna

Regional. 58^c: White-striped Freetail Bat (5 roosting in Manna Gum at edge of Jacksons Gully about 100 m upstream of the Jumping Creek, north-east of The Common); only roost located for the species in NEM

Outlook

The Category 1 conservation status meets 17 sub-criteria. Despite excellent management works in Warrandyte SP, this is likely to decline due to an inability of fauna in the habitat refugia to cope with rising levels of impact from humans and severance of habitat links due to surrounding land subdivision.

FAUNA

Rare or Threatened Fauna

- Bb* **58^c: Swift Parrot.** Two birds in flowering Manna Gum riparian forest (5.1) on the riverbank at Black Flat on 10 March 1988.
- Bc* **58^{abd}: Powerful Owl.** Nested in Manna Gum riparian forest (5.1) near the Norman Reserve upstream of Pound Bend from 1991 to 1993 and shifted to Blooms Road, North Warrandyte in spring 1994 (site 56). Survey sightings of roosting birds at Fourth Hill in January 1992 and Andersons Creek in October 1993. For further discussion see site 57.
- Bc* **58^c: Brush-tailed Phascogale.** Roaming males at the beginning of the breeding season are vulnerable to predation and road mortality. Road kills were recorded along Jumping Creek Road opposite The Common on 10 March 1987 and 27 April 1987. One was a male and the other was unidentified. The surrounding habitat is Red Box–Red Stringybark box–stringybark woodland (11.1) and Yellow Box–Candlebark valley forest (31.1). The phascogale is apparently rare in the western section of Warrandyte State Park due to severance of habitat links and probable predation from domestic cats.
- Bc* **58^{bc}: Common Bent-wing Bat.** While no confirmed, regular Common Bent-wing Bat roosts are known from the site, some of the mines in the area appear to be used as temporary shelters (e.g. Johnsons Mine and Victory Mine). Geraughtys Mine contained several hundred Common Bent-wing Bats in the 1960s (Bryan Walters pers. comm.). The mines were subjected to increasing visitation and disturbance from humans around this time and bat populations dwindled. The Victory Mine now contains a grill and provides a roost for a small number of bats (Steve Anderson pers. comm.). Re-establishment of the colony should be monitored.
- Dead Common Bent-wing Bats were found in Johnsons Mine in 1992 and 1993. This mine is frequently visited by humans. Disturbance to bats would be prevented by a grill. Recent droppings of the Common Bent-wing Bat were located in a horizontal shaft (15 m long) on private property to the east of Parson Gully (south of Black Flat) on 10 March 1988.
- Bc* **58^d: Large-footed Myotis.** One was trapped in Manna Gum gully woodland (10.1) along Andersons Creek near the gold memorial in January 1992 (Martin Schulz pers. comm.). This species is known to roost in Pound Bend Tunnel and may also roost locally in mines near the Yarra River. The creeks provide foraging areas and dispersal corridors for cave-bats.
- Bc* **58^a: Freshwater Blackfish.** One was electrofished at Forbes Street on 3 November 1988. There are historical records of the vulnerable Australian Grayling and potentially threatened Spotted Galaxias at Warrandyte. These migratory species had been prevented from passing the weir at Dights Falls until the construction of a fish-way in 1993. They will likely be recorded in the future.

Other Significant Fauna

Frogs

- Ef* **58^{bd}: Southern Toadlet at Whipstick Gully and Andersons Creek.** This species mainly occurs in the upland hills and ranges. It occupies damp gullies in the lowland hills and is replaced by Bibron's Toadlet on the plains.

Freshwater fish

- De* **58^a: Yarra River at Warrandyte township.** Five species were recorded (Raadik in prep.): the Short-finned Eel, Australian Smelt, Murray Cod, Macquarie Perch and Freshwater Blackfish. The Australian Smelt was seine-netted from the Yarra at Webb Street on 3 July 1989 and Forbes Street on 14 August 1991. See site 57 for further discussion of fish recorded in the Yarra near the Pound Bend Tunnel exit.

Butterflies

- 58^b: Fourth Hill.** Twenty-three species have been recorded (Michael Braby pers. comm.). Significant species are Donnysa Skipper, Spotted Skipper, Phigalia Skipper, Phigalioides Skipper, Bank's Brown, Meadow Argus, Bright Copper and Blue Jewel and Common Dusky Blue. There was an unconfirmed sighting by John Burns of the rare Genoveva Azure near Geraughtys Mine around 1988 (Michael Braby pers. comm.). The larval food-plant is Box Mistletoe, which is locally common on Yellow Box and Long-leaf Box. The azure had been taken in the 1920s near the present site of the Mitchell Avenue community centre (Michael Braby pers. comm.).

MANAGEMENT

(See other sites in the Yarra Lowland Hills and particularly site 57 which includes a portion of Warrandyte SP downstream of Pound Bend.)

Threatening Processes	Conservation Measures
<p>The main issues include:</p> <p>Habitat loss and fragmentation due to urban growth.</p> <ul style="list-style-type: none"> • Predation of native fauna by domestic pets. • Disturbance effects from the urban fringe and recreation pressures. Conservation values at Warrandyte SP are in conflict from being on the urban fringe and high visitor usage. These will inevitably lead to habitat degradation and deterioration. • Horse riding in the park at Fourth Hill. The level of riding access at Fourth Hill, Fifth Hill and the Timber Reserve is incompatible with the maintenance of the conservation values of the area. Riders access areas that contain significant orchid populations. It is clear that riders do not keep to the main trail. They appear unaware of the sensitive nature and significance of plants in the area and the impact of transgressions onto native vegetation. Ground compaction, erosion and weed outbreaks are occurring along the tracks. 	<p>Habitat connectivity. Strategic Habitat Link. Intact habitat links upstream to the Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands site, north to the Stony Creek–Pigeon Bank–Laughing Waters Creek site and downstream to the Pettys–Sweeneys–Paddles–Morrison–Glynns site.</p> <p>Strengthen strategic habitat link.</p> <p>Management initiatives and objectives for Warrandyte State Park are outlined in the Management Plan (DCE 1990b; pp. 2 & 19). Particular reference in the Management Plan should be made to the aims and actions for vegetation management (p. 34), fauna management (p. 43), the Yarra River environs (p. 51), park access (p. 62), residential development (p. 93) and Yarra Valley Park (p. 95).</p>
Regional Hydrological Strategy	
	<p>Streamway management.</p> <p>Require long-term improvement in water quality of the Yarra and its tributaries.</p>

Conservation Measures Relating to Other Issues

Cave-bat management plan and research. Substantial numbers of Common Bent-wing Bats roosted in the mines of Warrandyte in the 1960s. The bats have deserted the mines primarily because of disturbance (i.e. heavy visitation by humans). A grill at Victory Mine has closed off access to the public. This has enabled the re-establishment of a small roosting colony of the bat. Most roosts nearer Melbourne have been eliminated and all in NEM have declined over the last two decades. There is cause for concern for the conservation of the species in NEM. The closure to the public of other mines in the site by the installation of grills is a desirable conservation measure for cave-bats.

An inventory of roosting sites and the use of these by bats over time is the critical resource information required for an effective management plan. These data, particularly the use of human-made structures such as mines and tunnels, would provide insight into the conservation and ecology of cave-bats in Victoria. With careful management the roosts could be used for research. There is little information on movements and seasonal occupation of human-made structures by cave-bats. A banding and recapture study using ANPWS approved bat bands would be invaluable.

Public usage. Public access to the river must be restricted to specific points. It is important that significant or sensitive river frontages (e.g. cliffs) receive minimum human disturbance. Low levels of passive recreation (e.g. sensitively designed picnic areas and walking trails) are not incompatible with conservation of flora and faunal values, provided such activities are away from, or have no impact on, the riverbank, significant stands of native vegetation, and areas set aside for land or rare plant protection. Tighter regulations are needed on clearing of understorey vegetation on adjacent freehold land and control of feral and domestic animals and weeds. A fire management program has been formulated by the Department of Natural Resources and Environment.

Horse riding in the park—Fourth Hill, Fifth Hill and Timber Reserve. The riding needs regulating as damage and weed outbreaks are occurring along the tracks. Management must consider relocating tracks away from the significant orchid areas. A rider education program on conservation and the establishment of strict trail conditions is required. Horse riding tracks must be sited to consider (a) protection of conservation values (b) land capability (c) safety (d) integration with existing and proposed track networks (DCE 1990b). Conditions (a), (b) and (d) are being breached at Fourth Hill.

YLH C YARRA RIVER JUMPING CREEK TO YERING FLATS

This management unit consists of three sites of state faunal significance (sites 59, 60 and 62) and one site of regional faunal significance (site 61) and surrounding land that forms habitat links.

Map Reference: 7922 449218 to 7922 535385 (Yarra River).

Location/Size: The hills section of the middle Yarra River and lower reaches of Watsons Creek and adjacent catchments.

Municipality: Shire of Nillumbik (north of river) and City of Manningham and Shire of Yarra Ranges (south of river).

Physical Features

The unit forms part of the lowland hills of the Eastern Uplands. The landscape contains a section of the Middle Yarra River valley, steep hills with narrow hill-crests and ridges, steep (concave) hill-slopes and narrow V-shaped gullies. Land to the north of the Yarra Fault on the Yarra Plateau uplifted over the last million years. The Yarra River runs along the fault from north-east to south-west and over this period, shaped the major landforms, the Yering and Warrandyte Gorges, the escarpment of the Yarra Ridge and the Yering Flats.

The Yarra entrenched the Yarra Plateau at Yering Gorge and Warrandyte Gorge. The spurline of the Yarra Ridge lies 200 m above the floodplain of the Yarra River to the north of Yering Gorge. This marks the escarpment of the Yarra Plateau. Obstruction to the flow caused by the narrowing of the river at both gorges developed floodplains upstream on the south side of the river (Yering Flats). The Warrandyte Gorge runs from the mouth of Mullum Mullum Creek to Homestead Road.

The main tributary from the north is Watsons Creek, which has a broad, shallow valley. The section upstream of the mouth follows the course of an abandoned high level meander of the Yarra (of State geological and geomorphological significance; Rosengren *et al.* 1983). To the south, the terrain is steeper in the west and the creek valleys are deep and narrow (e.g. Jumping Creek) and flatter in the east where the creeks have broad valleys and floodplains (e.g. Brushy Creek).

Landforms

Foothill: ridges, hill-crests, hill-slopes, quartz-diorite volcanic plugs, gullies, valleys, creeks, river valley, gorges, cliffs, terraces, rapids, gold mine, aqueduct/tunnels, water storage reservoir, dams and artificial floodplain wetlands. Alluvial plain (upstream of Yering and Warrandyte Gorge): floodplains, billabongs and backswamps. Elevation is 30–280 m.

Hydrology

The Yarra River is a large, perennial stream and has formed a winding, incised valley. It is moderately fast-flowing and is characterised by gorges, rapids and cascading rock bars. The river generally has steep banks and cliffs. The meander bends have undercut cliffs on the outer (convex) side and gently sloped spurs with banks containing sand bars on the inner (concave) side. The pools are up to 8 m deep. The Warrandyte Gorge from Bouchiers Road to Homestead Road contains five major white-water rapids and over 20 cascades/rock bars.

Watsons Creek and Jumping Creek contain cobble and sheet-rock substrates, steep hill-slopes and damp gullies. The lower Brushy Creek formed an extensive marshland (now drained) and has a broad floodplain. The Jumping Creek originally flowed about 9 months a year but is now virtually perennial with urban development in the catchment. The Brushy Creek and Watsons Creek are perennial. The Brushy Creek (and Watsons Creek prior to the Sugarloaf Reservoir) has a small summer flow which ceases in dry years. The summer flow of Watsons Creek is largely fed by seepage from the Sugarloaf Reservoir.

Upstream of Warrandyte Gorge and Yering Gorge there is a floodplain which is predominantly on the south side of the Yarra River (Yering Flats). The Yarra Ridge rises abruptly on the north side. The river is relatively narrow and swift flowing through the Yering Flats compared with downstream in the Lower Yarra flats between Kew and Templestowe. The course is highly meandered and is displaced in several sections by the Yarra Fault. The extensive floodplain contains abandoned and newly forming ox-bow lagoons and channels, backswamps and deep alluvial soils,

demonstrating the ongoing cut and fill process of the river and floodplain development (Rosengren *et al.* 1983). Floodwaters breach over the low levee banks of the river and inundate extensive areas of the floodplain on at least an annual basis (mainly winter–spring).

The Yarra River catchment is about 4000 square kilometres. The average flow of the Yarra River at Warrandyte between 1960 and 1981 was 1360 ML/day (DCE 1990b). This is half the flow recorded over the period from 1892 to 1933, before the construction of major dams or water diversion works in the Upper Yarra. The months of highest mean flow are August and September and lowest mean flow are February and March (approximately five-fold differential). The river floods mainly in June and September/ October.

The water area of Sugarloaf Reservoir covers about 445 ha. The reservoir is filled from the pumping station at Yering Gorge which under ideal operation draws about 80 000 ML of water from the Yarra and an equal volume from the Maroondah Aqueduct each year. It is proposed that the uptake volume of the Yering Pumping Station will increase by a further 25 000 ML per year. The Winneke Treatment plant constructed below the south-west corner of the Sugarloaf Reservoir wall, delivers treated water via a pipeline to Reservoir and Melbourne's northern suburbs. The Maroondah Aqueduct downstream of the pumping station is no longer used directly in the reticulated system.

Rainfall: 750–820 mm.

Site 59 Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands

- Map Reference:** 7922 449218 to 7922 494248 (Yarra River from Jumping Creek to Homestead Road). One minute lat/long grids include 37° 42' x 145° 14' to 145° 17' and 37° 43' x 145° 14' to 145° 15'.
- Location/Size:** Yarra River and adjoining bushland from Jumping Creek to Homestead Road. Approximately 1200 ha.
- Municipality:** Shire of Nillumbik north of the Yarra and the City of Manningham south of the Yarra.
- Land Tenure/Use:** Public: NRE (Warrandyte SP–Jumping Creek–Blue Tongue Bend, Koornong, Stane Brae, Yarra Brae, Mt Lofty) and unreserved Crown land along northern river frontage proposed for park incorporation; Shire of Nillumbik (Oxley Reserve); City of Manningham (Wittons Reserve). Mt Lofty was acquired by Melbourne Water during the planning stage of the Yarra Brae Reservoir project. It is to be incorporated into Warrandyte SP. Private: bushblocks, grazing land including horse studs and riding schools, orchards, wineries and Clifford Park Scout Activity Centre (Scout Association of Australia). Private land in Henley Road/Catani Boulevard forms The Bend of Islands Environmental Living Zone. Warrandyte SP is 586 ha, about 270 ha (plus an additional 100 ha at Mt Lofty proposed for inclusion) of which occurs in this site.
- Landforms:** Foothill (see YLH C). Elevation is 30–140 m.

Natural Heritage Values

Landscape. The Yarra upstream of Warrandyte is a proposed Natural Heritage River. The river from 400 m downstream of Watsons Creek confluence to 500 m downstream of Homestead Road (excluding Wittons Reserve) supports an extensive system of white-water rapids and gorges. Warrandyte SP contains extensive and intact stands of riparian and river gorge habitats which are poorly represented in the biological reserve system of southern Victoria.

Scientific and Educational Values

Scientific reference. Proposed Warrandyte Gorge Ecological Reference Area (see conservation measures and planning recommendations).

Rehabilitation and management. Habitat restoration, revegetation, rare plant protection and weed eradication programs are high priority in the park. These need to be continued and adequately resourced. Friends of the Warrandyte SP.

Public interpretation. Ranger/Friends of the Warrandyte SP activities.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Manna Gum (riverbank) riparian forest (5.1; north bank of Yarra at Bends of Islands ELZ); Manna Gum (floodplain terrace) riparian forest (5.2; between Oxley Reserve and Bend of Islands); Red Stringybark herb-rich foothill forest (6.1; ELZ/Catani Boulevard); Narrow-leaf Peppermint herb-rich foothill forest (6.2; Yarra escarpment at Catani Boulevard); Manna Gum gully woodland (10.1; lower Jumping Creek); Messmate–Swamp Gum gully woodland (10.2; ELZ Gully); Swamp Gum gully woodland (10.3; Stane Brae Gully); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2; Gongflers Drive); Yellow Box–Candlebark valley forest (31.1; ELZ Gully)

Relatively intact and extensive stands: Manna Gum (creek) riparian forest (5.3); Messmate herb-rich foothill forest (6.3); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Box escarpment woodland (13.3); Muttonwood riparian scrub (18.1)

Partially intact or small stands: Golden Wattle cliff/escarpment shrubland (20.4); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5); Common Reed–Cumbungi seasonal wetland (25.7)

Rare species: Stream Club-sedge, Yarra Gum

Critical assemblages or populations: Warrandyte Gorge Ecological Reference Area (Bend of Islands/Yarra Brae). Strategic Habitat Link. The conservation status of the site is listed Category 1 largely due to the Warrandyte Gorge and Bend of Islands ELZ supporting nine reference stand habitats and a high diversity of regionally rare or threatened species

FAUNAL SIGNIFICANCE: Site 59 Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands

Assessment: State—Category 1 (B, C, D, E); Regional (B, C, D, E, F)

59^a: 37° 42' x 145° 15'; Warrandyte SP–Bourchiers Road/lower Watsons Creek

59^b: 37° 42' x 145° 16'; Bend of Islands ELZ and Warrandyte SP–Yarra Brae

59^c: 37° 42' x 145° 17'; Warrandyte SP–Mt Lofty and downstream St John of God

59^d: 37° 43' x 145° 14'; Warrandyte SP–Blue Tongue Bend/Jumping Creek/Stane Brae

59^e: 37° 43' x 145° 15'; Stane Brae

59^f: 37° 43' x 145° 16'; Yarra River, Wittons Reserve

A. Cited Zoological Significance

State. Yarra River and Little Yarra River site. **Regional.** Warrandyte SP and Watsons Creek Catchment and Yarra Ridge sites: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 59^{b,d}: Regent Honeyeater (3 at Market Garden Bend on 8 March 1988 and a pair at the east end of Osborne Road over the last week of November 1994)

Unranked. 59^a: Red-tailed Black-Cockatoo (1 amongst a flock of 10 Yellow-tailed Black-Cockatoos along Oxley Road in 1977)

b. Vulnerable fauna

State. 59^d: Swift Parrot (park list for Jumping Creek); Large Ant-blue butterfly (female observed ovipositing at Pigeon Bank Lane on 17 January 1988)

Regional. 59^e: Swift Parrot (park list for Stane Brae)

c. Rare fauna

State. 59^b: Powerful Owl, Barking Owl, Brush-tailed Phascogale, Common Dunnart, Tree Goanna

Regional. 59^d: Powerful Owl, Yellow-spot Jewel butterfly

Regional. 59^a: Freshwater Blackfish (lower Watsons Creek)

Regional. 59^e: Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

Regional. 59^d: 8 species including the Regent Honeyeater and Little Friarbird at Market Garden Bend on 8 March 1988

f. Breeding migratory insectivores

State. 59^b: 18 species including the Sacred Kingfisher, Rainbow Bee-eater, Brush Cuckoo, Dollarbird, Tree Martin, Rose Robin, Satin Flycatcher, Leaden Flycatcher, White-winged Triller, White-throated Gerygone and Rufous Songlark at Catani Boulevard/Market Garden Bend in November 1988

Regional. 59^d: 8 species including the Brush Cuckoo at Menzies Road opposite Blue Tongue Bend on 31 October 1987

h. Bats

Regional. 59^b: 7 species including the Gould's Long-eared Bat at Catani Boulevard west on 4 November 1988

Regional. 59^d: 6 species at Menzies Road opposite Blue Tongue Bend on 31 October 1987

j. Ground mammals

Regional. 59^b: 5 species including the Brown Antechinus and Bush Rat at Market Garden Bend on 8 March 1988

k. Frogs

Regional. 59^d: 7 species at Menzies Road opposite Blue Tongue Bend on 31 October 1987

Regional. 59^b: 6 species including the Southern Toadlet and Striped Marsh Frog at Catani Boulevard/ELZ Gully on 4 November 1988

l. Reptiles

Regional. 59^b: 9 species including the Black Rock Skink, Delicate Skink, Bougainville's Skink and Eastern Small-eyed Snake at Catani Boulevard/Bend of Islands ELZ on 4 November 1988

Regional. 59^d: 7 species including the White's Skink, Delicate Skink and Eastern Small-eyed Snake at Menzies Road opposite Blue Tongue Bend on 5 November 1988

m. Freshwater fish

Regional. 59^f: Short-finned Eel and Macquarie Perch netted at Wittons Reserve on 10 April 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 59^b: 176 species. **59^d:** 149 species

Regional. 59^e: 105 species

b. Native birds

State. 59^b: 131 species. **59^d:** 116 species

Regional. 59^e: 81 species

c. Native mammals

State. 59^b: 25 species

Regional. 59^d: 16 species. **59^e:** 15 species

d. Herpetofauna

Regional. 59^b: 21 species. **59^d:** 17 species. **59^e:** 9 species

f. Butterflies

State. 59^b: 33 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 59^b: 36 species. **Regional. 59^d:** 21 species. **Unranked. 59^e:** 9 species

b. Regionally endangered fauna (R1 species)

Regional. 59^b: 3 species. **Birds:** Dollarbird, Regent Honeyeater, Little Friarbird

Regional. 59^d: 1 species. **Birds:** Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

State. 59^b: 14 species. **Birds:** Barking Owl, Azure Kingfisher, White-throated Nightjar, Red-capped Robin, Hooded Robin, White-throated Gerygone, Cicadabird, Fuscous Honeyeater, Yellow-tufted Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot, Yellow-bellied Glider. **Reptiles:** Tree Goanna

Regional. 59^d: 5 species. **Birds:** Azure Kingfisher, White-throated Nightjar, White-throated Gerygone, Fuscous Honeyeater. **Fish:** Australian Smelt

Regional. 59^a: 2 species. **Frogs:** Lesueur's Frog. **Fish:** Freshwater Blackfish

Regional. 59^e: 1 species. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 59^b: 7 species. **Birds:** Darter, Pink Robin, Spotted Quail-thrush. **Mammals:** Feathertail Glider, Gould's Long-eared Bat. **Reptiles:** Black Rock Skink, Eastern Small-eyed Snake

Regional. 59^d: 6 species. **Birds:** Little Corella, Fork-tailed Swift, Pink Robin. **Mammals:** Feathertail Glider. **Reptiles:** Eastern Small-eyed Snake. **Butterflies:** Yellow-spot Jewel

Regional. 59^e: 2 species. **Birds:** Spotted Quail-thrush. **Mammals:** Feathertail Glider

Regional. 59^f: 1 species. **Fish:** Macquarie Perch

e. Regionally depleted fauna (R4 species)

State. 59^b: 14 species. **Birds:** Buff-banded Rail, Rainbow Bee-eater, Whistling Kite, Peregrine Falcon, Powerful Owl, Australian King-Parrot, Leaden Flycatcher, Eastern Whipbird, White-winged Triller, Bassian Thrush, Rufous Songlark. **Mammals:** Platypus. **Butterflies:** Spotted Brown, Blue Jewel

Regional. 59^d: 10 species. **Birds:** Peregrine Falcon, Powerful Owl, Swift Parrot, Leaden Flycatcher, Eastern Whipbird, White-winged Triller, Bassian Thrush, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** White's Skink

Regional. 59^e: 6 species. **Birds:** Buff-banded Rail, Swift Parrot, White-winged Triller, Bassian Thrush, Speckled Warbler. **Mammals:** Platypus

f. Regionally restricted fauna (R5 species)

Regional. 59^b: 24 species. **Birds:** Painted Button-quail, Brush Bronzewing, Great Egret, Nankeen Night Heron, Little Eagle, Australian Hobby, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** Delicate Skink, Bougainville's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure, Chequered Blue

Regional. 59^d: 17 species. **Birds:** Painted Button-quail, Brush Bronzewing, Pied Cormorant, Nankeen Night Heron, Royal Spoonbill, Australian Hobby, Purple-crowned Lorikeet, Little Lorikeet, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Reptiles:** Common Long-necked Tortoise, Delicate Skink. **Frogs:** Striped Marsh Frog. **Butterflies:** Doubleday's Skipper

Regional. 59^e: 8 species. **Birds:** Brush Bronzewing, Nankeen Night Heron, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** Delicate Skink

g. Nesting birds of prey/parrots

Regional. 59^b: Powerful Owl (Bend of Islands ELZ in spring 1990)

Regional. 59^d: Wedge-tailed Eagle (Manna Gum along the Yarra at Stane Brae in October 1986); Yellow-tailed Black-Cockatoo (Manna Gum along the Yarra at Blue Tongue Bend in October 1987)

F. POPULATION DENSITY: Viability and Abundance—point census

h. Other fauna

Regional. 59^b: Tree Dragon (one of the highest population densities recorded in GM at Bend of Islands/Yarra Brae)

i. Bat trapping rate

Regional. 59^b: trap-night average of 24 bats (of 7 species) at Catani Boulevard west on 4 November 1988

k. Regionally endangered fauna (R1 species)

Regional. 59^b: a dozen Little Friarbirds in flowering Manna Gums at Market Garden Bend on 8 March 1988

Outlook

The significance will be maintained provided the conditions of the Bend of Islands Environmental Living Zone are maintained and further housing does not encroach into the bushland. Recreational impact on the streamway in Warrandyte SP needs to be kept to a low level. The Mt Lofty section of Warrandyte SP requires land protection and revegetation works.

FAUNA

Note. The following fauna discussions deal mainly with Yarra Brae/Bend of Islands, where most of the research and survey data for the site was gathered. Data on Jumping Creek/Stane Brae can be gleaned from the faunal significance key.

Rare or Threatened Fauna

Ba 59^a: Red-tailed Black-Cockatoo. One seen amongst a flock of 10 Yellow-tailed Black-Cockatoos along Oxley Road in 1977 (Jeph Neale pers. comm.). This was the year of an inland drought which possibly drove stragglers (similar to the Letter-winged Kite) to central Victoria. Red-tailed Black-Cockatoos had not been recorded in GM for possibly 100 years. Over the last decade, small numbers have commenced visiting the Kinglake NP–One Tree Hill area (see sites 80 and 103).

Ba 59^{bd}: Regent Honeyeater. Three in flowering Manna Gum riparian forest (5.1) at Market Garden Bend on 8 March 1988. A pair was also seen in Red Box–Red Stringybark box–stringybark woodland (11.1) at the Murphy property on the Osborne Road peninsula over the last week of November 1994. The birds at Osborne Road fed in flowering Red Box but failed to nest due to harassment from Bell Miners (David Van Bockel pers. comm.). The Regent Honeyeater population is believed to have declined to about 100 birds and the Yarra Brae sighting constitutes the largest number seen outside the Plenty Gorge at Yarrambat in GM since 1986 (see the Yarrambat–Morang Wetlands site).

Bb 59^d: Large Ant-blue. A female observed ovipositing amongst the cracks of a dead eucalypt stump in Red Box–Red Stringybark box–stringybark woodland (11.1) at Pigeon Bank Lane on 17 January 1988 (Michael Braby pers. comm.). The stump contained a nest of a small ant (*Papyrius* sp. *nitidus* complex), commonly called the ‘coconut ant’. This ant is presumed to attend the larvae of the butterfly. The bushland was cleared for a homesite and the butterfly has not been located since (Douglas & Braby 1992). Searches in October 1993 revealed another ant colony in nearby bushland and it is possible that the ant-blue is still present. Prior to this study, the only records for the ant-blue in NEM were from between Eltham, North Warrandyte and Kangaroo Ground in the 1980s (Douglas & Braby 1992). Large Ant-blues (predominantly males) were recorded hill-topping nearby at Kangaroo Ground on 11 occasions from 1981 to 1987.

Bc 59^b: Barking Owl. One roosting in a Cherry Ballart in Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2) at Gongflers Drive on 22 May 1988. The owl is regarded as resident, presumably breeding in the area (Fabian Douglas pers. comm.).

Bc 59^{bd}: Powerful Owl. An adult roosting in the canopy of Messmate–Swamp Gum gully woodland (10.2) above ELZ Gully about 200 m upstream of Catani Boulevard on 4 November 1988. They nested in spring 1990

in a tree hollow further up the gully (Dr Terry O'Brien pers. comm.). One heard calling at Blue Tongue Bend from the opposite side of the river at Menzies Road on 31 October 1987.

- Bc* **59^{be}: Brush-tailed Phascogale.** Several sightings in the 1980s in Red Box–Red Stringybark box–stringybark woodland (11.1) at Bend of Islands ELZ (Neil and Fabian Douglas pers. comm.). Also recorded several times in 11.1 at Stane Brae Court between 1986 and 1995 (David Van Bockel and Dr Terry O'Brien pers. comm.).
- Bc* **59^b: Common Dunnart.** Recorded in Red Box–Red Stringybark box–stringybark woodland (11.1) at Bend of Islands ELZ in the mid-1980s (Neil and Fabian Douglas pers. comm.). Still presumably present.
- Bc* **59^b: Tree Goanna.** One recorded at the Bend of Islands ELZ in 1986 by John McCallum (Jeph Neale pers. comm.). This is the only observation of the species in the lowlands of GM and indicates the effectiveness and importance of habitat links between the Yarra and Kinglake Ranges.
- Bc* **59^a: Freshwater Blackfish.** Present in Watsons Creek near the confluence with the Yarra (Wendy Henderson pers. comm.). The habitat along lower Watsons Creek is Manna Gum (creek) riparian forest (5.3).
- Bc* **59^d: Yellow-spot Jewel at Jumping Creek.** Recorded breeding in Manna Gum riparian forest (5.1) on the banks of the Yarra at Jumping Creek, where the larvae feed on Hazel Pomaderris (Michael Braby pers. comm.).

Critical Assemblages or Populations

- Cf* **59^b: High diversity of breeding migratory insectivores—Bend of Islands.** Eighteen migratory foliage insectivores were recorded breeding in November 1988. See following paragraphs.
- Db* **59^b: High diversity of breeding birds—Bend of Islands transect surveys, 1988.** Five transect surveys were conducted at the Bend of Islands ELZ from March to November 1988. Each survey covered approximately 5 km over three hours. These were on 8 March, 22 May, 17 July, 24 September and 4 November. The transect consisted of two legs starting and finishing at Oxley Reserve and a third leg along Gongflers Drive. The first leg followed the west section of Catani Boulevard for 600 m until the ELZ Gully, then upstream covering the middle section of both tributaries, then north-west along a spur west of Atunga to Henley Road and back to Oxley Reserve. The second leg followed a track to the Yarra and covered the river frontage at Bend of Islands and the opposing bank of Market Garden Bend, returning through bushland to Oxley Reserve. The opposite side of the river at Market Garden Bend was also visited on 8 March and 24 September. The third leg was a 200 m section of Gongflers Drive flanking the cliffs opposite Clifford Park.

Habitats surveyed during the transects include: Manna Gum (riverbank) riparian forest (5.1; Yarra at Clifford Park opposite Gongflers Drive), Manna Gum (floodplain terrace) riparian forest (5.2; between Oxley Reserve and Bend of Isles); Red Stringybark herb-rich foothill forest (6.1; Catani Boulevard); Messmate herb-rich foothill forest (6.3; above ELZ Gully); Messmate–Swamp Gum gully woodland (10.2; ELZ Gully); Red Box–Red Stringybark box–stringybark woodland (11.1; Henley Road); Red Box escarpment woodland (13.3; Gongflers Drive); Yellow Box–Candlebark valley forest (31.1; Oxley Reserve); Muttonwood riparian scrub (18.1; Bend of Isles rapids); Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2; Gongflers Drive).

The combined transect survey total was 124 native species, 75 of which were breeding. This is the highest recorded diversity in NEM. Bend of Islands/Yarra Brae was the third most diverse 1' grid (131 species in total) for native birds in NEM. Significant observations:

- Eb* **59^b: Dollarbird and Little Friarbird.** Both species are spring-summer migrants from northern Australia and New Guinea. The Dollarbird was nesting in a Manna Gum hollow (5.1) at the northern end of Market Garden Bend on 4 November. Twelve Little Friarbirds were present in flowering Manna Gums (5.1) at Market Garden Bend on 8 March. Like the Regent Honeyeater, the Dollarbird and Little Friarbird have become rare in GM. Each is dependent on riparian forests and their decline in GM appears to be linked with streamway habitat fragmentation and degradation.
- Ec* **59^b: Azure Kingfisher.** A pair was breeding in the cliffs (20.2) along Gongflers Drive on 4 November. There were few breeding records in NEM and it is thought that the kingfisher is mainly a non-breeding, autumn-winter visitor.

- Ec* **59^b: White-throated Nightjar.** They are spring–summer breeding migrants from northern Australia and New Guinea. A single bird was seen on the exposed upper hill-slopes (11.1) of Oxley Reserve on 4 November. The species had been observed in this location on a previous occasion (Jeff Davies pers. comm.).
- Ec* **59^b: Red-capped Robin and Hooded Robin.** Both were recorded breeding on 24 September. The Red-capped Robin had a nest in a thicket of Black Wattle and Burgan (5.2) in a semi-cleared section of Market Garden Bend. The Hooded Robin had a nest in a Tree Banksia (20.2) on the cliffs at Gongflers Drive.
- Ec* **59^b: White-throated Gerygone and Cicadabird.** Both are uncommon spring–summer breeding migrants from northern Australia and New Guinea. The gerygone was breeding in a Candlebark (31.1) at Oxley Reserve on 4 November and the Cicadabird was heard (presumably breeding) the same day in Messmates (6.3) on the sheltered hill-slope north of ELZ Gully upstream of Catani Boulevard.
- Ec* **59^b: Fuscous Honeyeater and Yellow-tufted Honeyeater.** Both recorded in flowering Swamp Gums (10.2) along ELZ Gully on 22 May. These birds visit NEM from breeding areas such as the goldfields of northern Victoria for winter flowering eucalypts including Swamp Gum, Red Ironbark and Yellow Gum. Both honeyeater species, but more particularly the Yellow-tufted, have declined in NEM.
- Ed* **59^b: Spotted Quail-thrush.** Breeding in a tussock of Silvertop Wallaby-grass (13.3) along Gongflers Drive on 4 November. Few other breeding records of this species were made in the lowland hills.
- Ee* **59^b: Rainbow Bee-eater.** They are spring–summer migrants from northern Australia and New Guinea. A pair nested in the riverbank (5.1) at the north end of Market Garden Bend on 4 November. This species has declined alarmingly along the Yarra over the last two decades.
- Ee* **59^b: Bassian Thrush.** Breeding amongst dense Burgan along ELZ Gully (10.2) just downstream of Catani Boulevard on 4 November. There is a substantial population of Bassian Thrush in the site. This is indicative of the low domestic cat population in the area.
- Ee* **59^b: Eastern Whipbird.** Heard in the Burgan along ELZ Gully (10.2) at Catani Boulevard on 17 July. They have become rare along the Yarra. Breeding populations occur along Watsons Creek near One Tree Hill. Birds move down the creek to the Yarra in autumn–winter.
- Ee* **59^b: White-winged Triller and Rufous Songlark.** These migrants from north-eastern Australia were both nested at Oxley Reserve in Yellow Box (31.1) on 4 November. Both are rare in the dense forests and woodlands of the Middle Yarra, being more frequently seen in the open box–stringybark and grassy woodlands of the Plenty Lowland Hills and Volcanic Plains.
- Ef* **59^b: Painted Button-quail.** Breeding on the Gongflers Drive spur (13.3) on 4 November.
- Ef* **59^b: Brush Bronzewing.** Breeding in dense Burgan (5.2) on the river terrace of Bend of Islands on 4 November.
- Ef* **59^b: Rose Robin and Brush Cuckoo.** These migrants from north-eastern Australia were breeding on 4 November. The Rose Robin had a nest in dense Burgan along ELZ Gully just downstream of Catani Boulevard (10.2). The robins were engaged in driving off a presumably gravid, female Brush Cuckoo. Both species breed in the undergrowth and few records of each were obtained in the lowlands of NEM.
- Ef* **59^b: Pink Robin and Olive Whistler.** Non-breeding autumn–winter visitors from the ranges to shrublands along the river and adjoining gullies. The robin was recorded on 22 May at the Bend of Islands (18.1) and the whistler was recorded on 17 July along ELZ Gully (10.2). They were absent on the spring visits.
- Ef* **59^{ab}: Red-browed Treecreeper.** A colony of about 12 to 15 birds was present in the dense stand of Manna Gums (5.1) at the confluence of Watsons Creek (5.1). Smaller colonies were observed at Bend of Islands (18.1) and in the Swamp Gums (10.2) along ELZ Gully. They also occur along Watsons Creek at Oxley Bridge in Manna Gum (creek) riparian forest (5.3). The Red-browed Treecreeper is locally common, the habitat link to the uplands along Watsons Creek being critical for the species. They are rare downstream along the Yarra.
- 59^b: Birds of prey.** A pair of Wedge-tailed Eagles was seen over Market Garden Bend on 8 March and single birds were seen over Catani Boulevard on 22 May and Warrandyte Gorge at Gongflers Drive on 17 July. They were not recorded in the spring visits, indicating they bred elsewhere. A Little Eagle was seen over Warrandyte Gorge at Gongflers Drive on 8 March. The locally rare Whistling Kite was seen in the same locality on 22 May.

The Peregrine Falcon and Australian Hobby were seen on 4 November. The peregrine coursed the river between Gongflers Drive and Mt Lofty and the hobby flew over the Manna Gums of Market Garden Bend, both presumably in search of prey such as the Common Starling, nesting in the Manna Gums.

59^b: Rufous Fantail and Olive-backed Oriole. Several pairs of both species were nesting in stands of Burgan on the river terrace (5.2) and along ELZ Gully (10.2) on 4 November.

59^b: Fairy Martin and Tree Martin. Fairy Martins were nesting in the cliffs amongst Golden Wattle cliff/escarpment shrubland (20.4) to the east of Ironbark Road on 4 November. Tree Martins were nesting in Manna Gum hollows (5.1/5.2) at Market Garden Bend on 4 November.

Df **59^b: High diversity of butterflies—Bend of Islands Environmental Living Zone.** Thirty-three species have been recorded at the ELZ, 30 of these by Fabian Douglas. Significant species: Donnysa Skipper, Spotted Skipper, Phigalia Skipper, Phigalioides Skipper, Cyril's Brown, Bank's Brown, Spotted Brown, Meadow Argus, Blue Jewel, Dark Purple Azure, Common Dusky Blue and Chequered Blue. The Small Grass Yellow and Chequered Swallowtail were recorded as vagrants. Three additional species were recorded by this author in 1996. These included the Common Silver Xenica (18 March) and Flame and Doubleday's Skippers (26 November).

Ed **59^b: Common Silver Xenica on Ironbark Road river terrace.** Recorded on one occasion in the 1970s at Bend of Islands (Fabian Douglas pers. comm.). Located by this author on the river terrace (Manna Gum riparian forest; 5.2), at the south end of Ironbark Road on 18 March 1996. An adult (possibly a female) was flushed from a clump of a locally rare grass of mountain heaths and gullies, the Hairy Rice-grass. The xenica was recorded breeding on this grass in wet heath at Broad Gully in Kinglake NP (site 103). The distribution and habitat in Victoria of the Common Silver Xenica is largely restricted to mountain forests and heaths, sub-alpine grasslands and coastal heathlands. It is locally common in heathy woodland and damp sclerophyll forest in the ranges of NEM.

Bend of Islands is the only known lowland occurrence in NEM, indicating a biogeographic lineage between the Middle Yarra and the coast and ranges (other local mountain forest species include the Mountain Grey Gum and Gould's Long-eared Bat). The butterfly was recorded in the 1940s in the Heathmont-Bayswater area, where it now appears to have become extinct due to urban development. The Common Silver Xenica flies between February and April. Larvae elsewhere have been reported to more commonly feed on Weeping Grass and tussock-grasses (*Poa*). Although these plants are common in the lowlands, the butterfly is not.

Ee **59^b: Flame Skipper on ELZ Gully at Catani Boulevard.** Recorded on 25 November 1996 along ELZ Gully upstream of Catani Boulevard. The Flame, the Donnysa Skipper and the Spotted Skipper were observed in Messmate-Swamp Gum gully woodland (10.2). Each was seen feeding in a stand of flowering Burgan, in a sunny section of the valley. The gully and adjoining sheltered hill-slope of Messmate herb-rich foothill forest (6.3), contains abundant areas of Thatch Saw-sedge, the presumed larval food-plant of all three species.

Ef **59^b: Doubleday's Skipper at Gongflers Drive cliffs.** The sunny herbfields under Burgan-Sweet Bursaria cliff/escarpment shrubland (20.2) are fine feeding, breeding and territorial areas for butterflies. The Doubleday's Skipper, Phigalia Skipper, Phigalioides Skipper and Meadow Argus were recorded on 25 November 1996. The butterflies were feeding on several flowering ground daisies, notably the regionally vulnerable Tall Daisy. The presumed larval food-plant of the Doubleday's (Weeping Grass) and of the Phigalia and Phigalioides (Wattle Mat-rush) were locally abundant. A female Meadow Argus was observed ovipositing amongst the Shade Plantain.

Other Significant Fauna

Birds

59^b: other bird sightings. A birdlist of 101 native species for the Catani Boulevard area was provided by Frank Pierce. Species not recorded in the 1988 bird surveys included: Buff-banded Rail, Yellow-billed Spoonbill and Australian King-Parrot.

59^b: Superb Lyrebird. They were present at Bend of Islands prior to the 1962 bushfire. With the improvement of the habitat link along Watsons Creek and maintenance of controls on domestic cats, there is a possibility of the lyrebird returning.

Mammals

Ec **59^b: Long-nosed Bandicoot.** Recorded in ELZ Gully at Bend of Islands in the mid-1980s (Neil and Fabian Douglas pers. comm.). Still presumably present in Messmate–Swamp Gum gully woodland (10.2). The site supports the highest ground mammal diversity recorded along the Yarra (10 species including the Water Rat and Platypus; both seen in the river on several occasions). The Brown Antechinus and Bush Rat were trapped in Warrandyte SP at Market Garden Bend on 8 March 1988.

Ec **59^b: Yellow-bellied Glider at Gongflers Drive.** One heard by the river in Manna Gum riparian forest (5.1) by Mick Woiwod in 1987 (via Bernie Mace pers. comm.). This is one of few occurrences of the glider in the lowlands of NEM. After a long absence, the species is now making a comeback. This would be assisted by improving the effectiveness of the Watsons Creek habitat link between the Yarra and Kinglake Ranges.

Ed **59^b: Feathertail Glider.** Recorded at Bend of Islands ELZ (Neil and Fabian Douglas pers. comm.).

Ed **59^b: Gould's Long-eared Bat.** A trap-night average of 24 bats of seven species including the Gould's Long-eared Bat was recorded over 4/5 November 1988 from a harp trap set in Manna Gum (terrace) riparian forest (5.2) along an old vehicle track off the west section of Catani Boulevard. The Gould's Long-eared Bat is an upland species. The animal was a lactating female and represents the only capture made of the species in the lowlands during the breeding season. Other lowland captures have been in late summer–autumn and it is thought that the species disperses from upland breeding areas at this time of year. Bend of Islands appears to support a disjunct local breeding population.

59^a: Cave-bats. There is a gold mine near the quartz-feldspar outcrop in the north escarpment of the Yarra, downstream of Watsons Creek. This mine could not be located as the terrain was steep, inaccessible and covered with dense Burgan. The area is undisturbed and cave-bats are known to roost nearby in the Maroondah Aqueduct tunnels. The mine forms a mid-point on the presumed path for Common Bent-wing Bats dispersing along Watsons Creek and the Yarra River between One Tree Hill Mine, the Maroondah Aqueduct tunnels and Pound Bend. Few mines were unsearched during the study and it is important to ascertain whether this one supports cave-bats. It would also be possible that the Large-footed Myotis roosts in the cliffs of Warrandyte Gorge.

Frogs

Ec **59^a: Lesueur's Frog.** This species inhabits rock pools, rock bars and cliff ledges of perennial streams. They have a very localised distribution in NEM, confined to the quartz-diorite rapids and adjoining sheltered cliffs downstream of Watsons Creek. These habitats include Muttonwood riparian scrub (18.1) and Burgan–Sweet Bursaria cliff/escarpment shrubland (20.2). Several were located under rocks on the riverbank and in rock pools on the granite bars in the river on 5 November 1988.

They are quiet compared to other tree frogs. The male emits a high pitched trilling whistle not readily audible to the human-ear. The breeding season is from September to January, while the flow of the river is high. Egg-masses located along the Deep Creek at Bulla in Western Melbourne were laid in rock pools in a solid gelatinous mass which adhered to the substrate. The eggs are small and dark-pigmented. Embryonic development is fairly rapid, hatchlings appearing in late spring. Larval development time is only three to four months and metamorphosis occurs from February to April.

The tadpole of the Lesueur's Frog is relatively large, has a flattened body, muscular tail and narrow fins. Early stage tadpoles occur in fast-flowing (lotic) water, while later stages retreat to quieter rock pools. The tadpoles cling to rocks by means of their powerful and large sucking mouths and are strong swimmers. They scrape algae and other vegetation from the rock surface. Adults pounce from rocks for flying or crawling insects and leap into the water, swimming after aquatic invertebrates. They are encountered at night along rock bars and cliff ledges by the river or when uncovered by day under mats of algae around rock pools or under loose rocks on the lower cliff ledges and in old channels on the river terraces.

The Lesueur's Frog has specialised breeding and larval feeding requirements. Reduced rates of water flow during spring and summer due to water catchment reservoirs and water diversions has depleted populations in GM (Coventry & Hutchinson 1978). Changing hydrological patterns due to tree clearing (e.g. increased volume and shortened periodicity of runoff) and farm dams in the catchment may also be significant factors. The distribution of the frog in GM is highly fragmented. It may be a biogeographical relict of the warm and wet climates of the post-glacial phase of 8000 to 10 000 years ago. The nearest known population in the Yarra system is 40 km distant near Warburton. Other populations in the Upper Yarra may have been eliminated by the construction of the Maroondah and Upper Yarra Reservoirs, as the Yarra Brae Dam would have done in NEM.

Reptiles

Ed **59^b: Black Rock Skink.** Two were seen basking on sunny rock ledges of an exposed cliff in Golden Wattle cliff/escarpment shrubland (20.4) on the east side of Ironbark Road on 4 November 1988. The skink is sedentary and usually occurs in small groups. They are agile and relatively swift moving and can climb vertical rock faces. They hibernate in the interior of the cliff crevices during winter. Black Rock Skinks give birth to live young (usually two) and their diet is predominantly of larger invertebrates, particularly beetles and spiders, with a smaller component of plant material including fungi.

The Black Rock Skink is widespread in the Eastern Uplands of Victoria including the ranges of NEM, but populations are restricted and fragmented in central and western Victoria. They are rare and localised in the lowlands of GM with a scattering of records from river gorges and granitic peaks. The only occurrences in the lowlands of NEM are the Warrandyte and Yering Gorge.

Ed **59^{bd}: Eastern Small-eyed Snake.** Recorded at Henley Road above Oxley Reserve in Red Box–Red Stringybark box–stringybark woodland (11.1) on 4 November 1988 and opposite Blue Tongue Bend at Menzies Road in Red Box escarpment woodland (13.3) on 5 November 1988. The species is widespread on the hill-crests and exposed escarpments.

59^b: Tree Dragon and Southern Water Skink. There are substantial populations of both species amongst the log debris, rocks and shrublands along the river banks, terraces and escarpments.

Freshwater fish

59^{df}: (provided in Raadik, in prep.). Australian Smelt: netted at Jumping Creek Reserve in 1986. Short-finned Eel and Macquarie Perch: netted at Wittons Reserve on 10 April 1991. Short-headed Lamprey: museum specimen labelled 'Murrumbidgee Stud' Wonga Park, 27 April 1975; likely still present.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. Intact habitat links to the Pound Bend–Fourth Hill–The Common–Black Flat site, Henley Road to Watsons Creek site, Round the Bend Cooperative–Maroondah Aqueduct site and Yering Gorge–Yering Flats site.

Strategic Habitat Link

Warrandyte Gorge Ecological Reference Area

(ERA). The Yarra River streamway (100 m to either side of each bank) from 400 m downstream of the Watsons Creek confluence to 500 m downstream of Homestead Road (excluding Wittons Reserve which is open to public access) is the proposed Warrandyte Gorge ERA. The ERA concept is to protect areas containing the most significant occurrences of important, rare and sensitive species, habitats and landforms within the biological reserve system from human impact and disturbance. The compromise of increasing levels of human disturbance in ERAs will lead to the disruption of integral ecological processes and restrict their function as biological reserves and 'control' areas for scientific research (both primary purposes of ERAs).

 Regional Hydrological Strategy

Streamway management.

Require long-term improvement in water quality of the Yarra and its tributaries.

Other Issues

The regional strategy sections of management have not been presented as, at the time of survey, over 90% of the site was in the (now) City of Manningham, outside the constituent councils of NEROC. See other sites in the Yarra Lowland Hills (particularly site 57) for further discussion. The main issues include:

- Horse riding in the park at Yarra Brae.** The level of riding access available to the Yarra Brae section of the park is incompatible with the Ecological Reference Area concept and the maintenance of conservation and wilderness values of the area. The trail passes through the most biologically significant section of the Yarra in Warrandyte SP. It is clear that riders do not keep to the main trail. Riders appear unaware of the sensitive nature of the riverbanks and the impact of transgressions onto native vegetation. There is also an element of disrespect shown toward park facilities. Two bat traps were damaged by riders on 9 March 1988. Ground compaction, erosion and weed outbreaks are occurring along the tracks.

The Yarra Brae section is recommended as an Ecological Reference Area, which requires that it remain restricted to uncontrolled public access. The concern is that by allowing horse riders the privilege of access to this section of the park, pressure from other user groups will follow.
- Clifford Park Scout Activity Centre.** The area at the Fulford Road entry and the surrounds of the activity centre are degraded. Severe soil erosion and trampling of the bushland is evident.

Management initiatives and objectives for Warrandyte State Park are outlined in the Management Plan (DCE 1990b; pp. 2 and 19). Particular reference in the Management Plan should be made to the aims and actions for vegetation management (p. 34), fauna management (p. 43), the Yarra River environs (p. 51), park access (p. 62), residential development (p. 93) and Yarra Valley Park (p. 95).

Horse riding in the park at Yarra Brae. Riding may be a privilege along the main trail in the park but riders must care for native vegetation and park property. The expanding rate of the activity needs regulating as damage and weed outbreaks are occurring along the tracks. The main trail access is from Fulford Road and the rear of horse stud/riding schools at Yarra Brae. This traverses sections of the proposed ERA. Management must consider prohibiting riding from the proposed ERA in accordance with the requirement of Ecological Reference Areas, which are essentially non-public access areas. Horse riding must be restricted to designated trails within areas of lower environmental sensitivity/significance external to the ERA.

In addition, a rider education program on conservation and the establishment of strict trail conditions is required. Horse riding tracks must be sited to consider (a) protection of conservation values; (b) land capability; (c) safety and; (d) integration with existing and proposed track networks (DCE 1990). Conditions (a), (b) and (d) are being breached at Yarra Brae.

Clifford Park Scout Activity Centre. Environmental works on the property and adjacent sections of Warrandyte SP conducted by the scouts would have great merit. The impacts of scout activities on Warrandyte SP needs to be minimised (DCE 1990).

• **Native fauna imbalances and weed outbreaks resulting from bushland subdivision.**

The population concentration of White-winged Choughs at Catani Boulevard/Henley Road has severely depleted native orchid populations. (Factors leading to artificially high populations of choughs are raised in site 68.) Damage to orchids by rabbits was also evident. Disturbance and habitat fragmentation has promoted annual grasses such as the Large Quaking Grass and Squirrel-tail Fescue and the perennial Panic Veldt Grass and Sweet Vernal-grass over the last decade.

Problem native species. Local residents need to be educated on the relationship between hand feeding (or availability of food) in sustaining artificially high populations of native species (e.g. White-winged Choughs) and declining orchid populations.

Public access to the river. This must remain restricted and carefully monitored to specific points (e.g. Wittons Reserve). Exceptions on public use in the adjacent ERA would include walking, nature study, and controlled passive water activities such as canoeing (conditional on the prohibition of overnight camping, shooting and fishing).

Planning Recommendations

Warrandyte Gorge Ecological Reference Area (ERA). The proposed ERA contains: the Yarra River streamway (100 m to either side of each bank) from 400 m downstream of the Watsons Creek confluence to 500 m downstream of Homestead Road (excluding Wittons Reserve which is open to public access). The ERA requires restricted public access conditions (for exceptions see conservation measures) and conservation of all native habitat and potential native habitat to be the principal planning/land-use priority. The ERA encompasses land in Warrandyte SP and contains specific conservation and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). A buffer zone is provided by the Environmental Living Zone to the north of the river and land within the SP to the south of the river. The negotiation of conservation covenants or similar conservation agreements as to the management of adjacent freehold bushland would be desirable.

Designated threatened or depleted landform, habitat, assemblage or species categories in the ERA include river valley, rapids and gorge—Manna Gum riparian forest (5.1/5.2), Red Box escarpment woodland (13.3), Muttonwood riparian scrub (18.1) and cliff/escarpment shrubland (20.2/20.4); migratory insectivore birds including the Rainbow Bee-eater and Dollarbird, and the Eastern Whipbird, Regent Honeyeater, Little Friarbird, Platypus, Koala, Yellow-bellied Glider, Black Rock Skink, Lesueur's Frog and Freshwater Blackfish.

Supportive categories in the Bend of Islands ELZ adjacent to the ERA include Red Stringybark herb-rich foothill forest (6.1), Messmate herb-rich foothill forest (6.3), Messmate gully woodland (10.2), Red Box–Red Stringybark box–stringybark woodland (11.1) and Yellow Box–Candlebark grassy woodland (31.1); Barking Owl and Powerful Owl and prey assemblages (including the Common Ringtail possum and Sugar Glider), Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot, migratory insectivore birds including the White-throated Gerygone and brown and skipper butterfly assemblages.

Bend of Islands Environmental Living Zone. Environmental living is a category of land-use zoning in the Nillumbik planning scheme to meet the dual aims of wildlife conservation and residential land-use in the biologically significant Bend of Islands area (the Bend of Islands Conservation Association 1991). The objective of the Environmental Living Zone is as follows:

Management controls will be implemented to maintain and enhance the positive environmental qualities of landscape, vegetation and habitat for native flora and fauna, and to protect specific sensitive areas from damage to the natural systems, consistent with the protection of existing occupation.

The ELZ contains specific controls on the clearing of native vegetation, the extent and type of roadings, buildings, excavations and gardens, the management of household wastewater and sewage effluent and other disturbances, the keeping of domestic pets and livestock and the planting of non-indigenous species. The ELZ nurtures community awareness and cooperation in the protection of the environment and fire safety. Houses are concentrated along Henley Road and Catani Boulevard. The interior of bushblocks combine to form an extensive area of undisturbed bushland.

Site 60 Round the Bend Cooperative–Maroondah Aqueduct

This site lies outside the area covered/funded by the five NEROC councils but has been included within the study area of North East Melbourne. Systematic faunal and habitat surveys were conducted. Due to contractual and time/financial constraints, the site has not been fully written up. Assessment keys on habitat and faunal significance and fauna lists are presented. The keys provide a systematic checklist of the relevant biological significance parameters present in the site.

The site boundaries are shown on Map 1. This will enable comparisons with neighbouring NEROC sites in the Yarra Lowland Hills and Nillumbik Upland Hills biophysical zones. Management discussions for the NEROC sites in the Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands site, Henley Road to Watsons Creek site, Watsons Creek to Christmas Hills site and One Tree Hill–Watsons Creek Link site are relevant to the Round the Bend Cooperative–Maroondah Aqueduct site as they are nearest neighbours along the Yarra to Kinglake habitat link. The Regional Habitat Link Strategy and descriptive texts under fauna in other sites on the Barking Owl (site 68), Powerful Owl (sites 57 and 63), Regent Honeyeater (sites 40 and 77), Brush-tailed Phascogale (site 80) and Common Dunnart (site 68) provide further reference.

Map Reference: 7922 496270 (mid-point). One minute lat/long grids include 37° 41' x 145° 17' to 145° 18'.

Municipality: Shire of Nillumbik.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Red Ironbark box–ironbark woodland (12.1)

Relatively intact and extensive stands: Messmate herb-rich foothill forest (6.3); Messmate–Swamp Gum gully woodland (10.2); Yellow Box–Candlebark valley forest 31.1; small but highly intact stands on the Maroondah Aqueduct easement)

Vulnerable species: Wine-lip Spider-orchid

Rare species: Delicate Beard-orchid, Shaved Beard-orchid, Bearded Greenhood

Critical assemblages or populations: Strategic Habitat Link. High orchid diversity; most extensive stand of Red Ironbark in NEM

FAUNAL SIGNIFICANCE: Site 60 Round the Bend Cooperative–Maroondah Aqueduct

Assessment: State—Category 3 (B, C, E); Regional (C, D, E, F)

60^a: 37° 41' x 145° 17'; Round the Bend ELZ/Maroondah Aqueduct

A. Cited Zoological Significance

Regional. Watsons Creek/Yarra Ridge site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 60^a: Regent Honeyeater (2 birds in flowering Red Ironbarks on Round the Bend ELZ at Track B/Skyline Road on 30 June 1988)

c. Rare fauna

State. 60^a: Barking Owl, Powerful Owl, Brush-tailed Phascogale, Common Dunnart

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

State. 60^a: 10 species (excluding the Red Wattlebird) from a 20-minute/2 ha flowering Red Ironbark count on Round the Bend ELZ at Track B/Skyline Road on 30 June 1988 (see *Fe*)

h. Bats

Regional. 60^a: 6 species (Lesser Long-eared Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Southern Forest Bat, Little Forest Bat and Large Forest Bat) trapped along the Maroondah Aqueduct service track near Tunnel No. 5 exit on 4 April 1992

i. Arboreal mammals

Regional. 60^a: 4 species including the Sugar Glider and Feathertail Glider spotted from the aqueduct service track on 11 April 1992

j. Ground mammals

Regional. 60^a: 5 species including the Common Dunnart on Round the Bend ELZ near the Maroondah Aqueduct Tunnel No. 5 exit on 4 April 1992

k. Frogs

Regional. 60^a: 7 species including the Striped Marsh Frog and Southern Toadlet on 4 April 1992 and 6 species including the Growling Grass Frog and Victorian Smooth Froglet on 11 April 1992 at Muirs dam on Stevenson Creek

l. Reptiles

Regional. 60^a: 6 species including the Weasel Skink, Bougainville's Skink and White-lipped Snake near the aqueduct tunnel exit on 4 April 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 60^a: over 130 species

b. Native birds

Regional. 60^a: over 90 species

c. Native mammals

Regional. 60^a: 20 species

d. Herpetofauna

Regional. 60^a: 17 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 60^a: 18 species

b. Regionally endangered fauna (R1 species)

Regional. 60^a: 1 species. **Birds:** Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

State. 60^a: 7 species. **Birds:** Barking Owl, White-throated Nightjar, Black-chinned Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 60^a: 7 species. **Birds:** Australian Spotted Crane, Pink Robin, Spotted Quail-thrush. **Mammals:** Feathertail Glider, Grey-headed Flying-fox. **Reptiles:** Eastern Small-eyed Snake, White-lipped Snake

e. Regionally depleted fauna (R4 species)

Regional. 60^a: 3 species. **Birds:** Latham's Snipe, Powerful Owl, Bassian Thrush

f. Regionally restricted fauna (R5 species)

Regional. 60^a: 10 species. **Birds:** Painted Button-quail, Brush Bronzewing, Australian Pelican, Great Egret, Nankeen Night Heron, White-winged Chough. **Mammals:** Koala. **Reptiles:** Bougainville's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

Regional. 60^a: substantial population of Brush-tailed Phascogales

e. Honeyeaters

Regional. 60^a: 255 on a 20-minute/2 ha count in flowering Red Ironbarks on Round the Bend ELZ at Track B/Skyline Road on 30 June 1988: 6 Black-chinned, 120 White-naped, 70 Brown-headed, 2 Regent, 4 Yellow-tufted, 30 Yellow-faced, 2 White-eared, 10 Fuscous and 6 Crescent Honeyeater and 5 Eastern Spinebill

m. Regionally rare fauna (R3 species)

Regional. 60^a: 6–8 (probably more) Grey-headed Flying-foxes recorded most nights from 16 May to 19 June 1996 in flowering Red Ironbarks at Tracks B and C (Steve Craig pers. comm.). The flying-foxes spread over different trees but were in constant vocal contact. These had dispersed 35 km from their roost site in the botanic gardens (see site 40).

Outlook

Conservation management at the Round the Bend Environmental Living Zone should maintain faunal and habitat values.

Management

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. An intact habitat link to the Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands site, Henley Road to Watsons Creek site, Watsons Creek to Christmas Hills site, Sugarloaf Reservoir site and Yering Gorge–Yering Flats site. The site is part of a contiguous foothills forest link between the Kinglake Ranges and Yarra Lowland Hills.

Review and ranking	Review and ranking
<p>References are to key sites elsewhere in Volumes 4 and 5 (foothills) where the management issue is discussed in relation to Red Stringybark herb-rich foothill forest (6.1), Red Ironbark box–ironbark woodland (12.1), Messmate–Swamp Gum gully woodland (10.2) or Yellow Box–Candlebark valley forest (31.1).</p>	<p>References: as for threatening processes.</p>

On-site Issues

Declining populations of significant plants and animals. *Reference:* sites 40, 68 and 77

Deleterious effects of past or present land-use caused by habitat fragmentation or degradation due to bushblock settlement. This is expressed in native species decline, tree dieback, erosion, pollution and weed invasion. *Reference:* sites 40, 68 and 77

Environmental weeds. Particularly disturbance areas near houses and tracks and along gullies. *Reference:* site 68

Continued operation of environmental principles in accordance with those of the Bend of Islands Conservation Association.

Reference: Volume 1 Regional Habitat Strategy—ELZs

Habitat manipulation (e.g. species-enrichment/weed control/fuel reduction burning). *Reference:* sites 68 and 77

Rare species/habitat protection works. Includes the preparation of population recovery plans. The principal biological significance hinges on conserving the integrity of the Red Ironbark woodland and rare orchid species. Construction of rabbit/kangaroo exclusion plots may be necessary to protect some populations of orchids. Emphasis needs to be placed on ground work identification of rare species/habitat values. Issues 2 and 3 are very important in the long-term. Implementation of rare species/habitat protection is critical in the short term. Prescription of a land and conservation management plan is essential. *Reference:* sites 40–42, 68, 77 and 80

Priority environmental weed control. Hills: Sweet Vernal-grass, Large Quaking-grass, Annual Veldt Grass, Panic Veldt-grass, Spanish Heath, Sweet Pittosporum Gullies: Drain Flat-sedge, Jointed Rush, Bridal Creeper, Brown-top Bent, Cocksfoot, Panic Veldt Grass, Yorkshire Fog, Toowoomba Canary-grass, Great Reedmace, Montpellier Broom, Blackberry. *Reference:* site 68, A3.4 in chapter 10 of Volume 1

Revegetation works to enhance external habitat links and reduce habitat and species fragmentation at the cooperative. Strengthening or restoration of habitat links to the Yarra River and along Stevenson Creek to the Watsons Creek is critical. The Watsons Creek is a Strategic Habitat Link connecting the Yarra River with the Kinglake Ranges. *Reference:* sites 40–42, 57, 63, 64, 68 and 77

Vermin and problem animals. The latter includes indigenous species such as the Bell Miner, White-winged Chough and Common Brushtail Possum whose populations are in imbalance with the natural ecosystem, leading to problems such as eucalyptus dieback or damage to significant ground flora. Vermin impact on conservation values in areas such as removal/degradation of native vegetation, predation of native animals, weed invasion and soil erosion. Rabbits are the major threat to ground flora. Other problem species include the Black Rat, feral cat and fox. *Reference:* site 68, and chapter 8 in Volume 1 for specific discussion of cats

Erosion. Sheet erosion of hill-slopes, gully erosion along watercourses is a major source of bushland weed invasion. *Reference:* Regional Hydrological Strategy and chapter 8 in Volume 1; site 68

Recreation and service impacts. These include road traffic (e.g. road-killed wildlife) and service easements (e.g. Maroondah Aqueduct). *Reference:* sites 57–59 and 64

Vermin control, particularly rabbits, foxes and feral cats. *Reference.* chapter 11 in Volume 1, site 57

Land protection works, particularly repair of gullies and other erosion surfaces. Retardation of nutrient enriched drainage from household runoff. *Reference:* sites 68 and 80

Recreation and service infrastructure management. This includes upgraded management of service easements including the Maroondah Aqueduct and Skyline Road. *Referenc:* sites 40–42, 64, 69 and 74

Off-site Issues

Habitat fragmentation and disruption of wildlife corridors by land clearing, livestock grazing and populations of weeds, foxes and rabbits in adjoining farmland are major problems. Other issues include: companion animals, human disturbances and habitat degradation (e.g. removal of mature trees and hollows, ground timber removal, pollution of watercourses from sewage/domestic outfall).

Environmental education, community conservation/land protection group and conservation covenant program through participating land-holders. Surrounding bushland forms viable flora and fauna habitat. Protection of these values could be best achieved through the formation of a LandCare group. For the Round the Bend Cooperative to maintain viable populations of plant and wildlife species, surrounding bushland needs to come under improved conservation management.

Site 61 Sugarloaf Reservoir

This site lies outside the area covered by the five NEROC councils but lies within the study area of North East Melbourne. It was visited on only two occasions and incidental bird sightings and habitat information were taken. No mammal trapping or reptile, nocturnal and flora surveys were conducted. Due to time and contractual constraints, the site has not been fully written up.

Assessment keys on habitat and faunal significance and fauna lists are presented. The keys provide a systematic checklist of biological significance parameters present. The site boundaries are shown on Map 1. This will enable comparisons with neighbouring NEROC sites in the Yarra Lowland Hills and Nillumbik Upland Hills biophysical zones.

Map Reference: 7922 510290 (mid-point). One minute lat/long grids include 37° 39' x 145° 19' and 37° 40' x 145° 17' to 145° 19'.

Municipality: Shire of Nillumbik.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference/relatively intact and extensive stands: nil

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Red Ironbark box–ironbark woodland (12.1)

Notable features: Red Ironbarks on west side of reservoir; scattered Snow Gums (ex-grassy woodland; 14.7) on north-east arm of reservoir; open water habitat for waterfowl and birds of prey

FAUNAL SIGNIFICANCE: Site 61 Sugarloaf Reservoir

Assessment: Regional—Category 3 (B, E)

61^a: 37° 40' x 145° 17'; Sugarloaf Reservoir, south-west sector

61^b: 37° 40' x 145° 19'; Sugarloaf Reservoir, north-east sector

A. Cited Zoological Significance

Regional. Watsons Creek/Yarra Ridge site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare

Regional. 61^a: White-bellied Sea-eagle (juvenile between the outlet tower and Mt Graham on 4 April 1992)

Unranked. 61^a: Letter-winged Kite: seen over the picnic area saddle ridge car park in 1978 (Hillary Jackman pers. comm.)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Local. 61^a: 15 species including the Musk Duck (1), Swamp Harrier (1), White-bellied Sea-eagle (1), Great Cormorant (3), Little Pied Cormorant (2), Little Black Cormorant (6) and Great Crested Grebe (2) on 4 April 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

b. Native birds

Local. 61^a: 39 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 61^a: 6 species

b. Regionally endangered fauna (R1 species)

Regional. 61^a: 1 species. **Birds:** White-bellied Sea-eagle

d. Regionally rare fauna (R3 species)

Regional. 61^a: 3 species. **Birds:** Great Crested Grebe, Caspian Tern, Musk Duck

e. Regionally depleted fauna (R4 species)

Regional. 61^a: 2 species. **Birds:** Swamp Harrier, Peregrine Falcon

f. Regionally restricted fauna (R5 species)

Local. 61^a: 1 species. **Birds:** Australian Pelican

g. Nesting birds of prey/parrots

Regional. 61^b: Peregrine Falcon (nest on the outlet tower)

Outlook

Management has maintained faunal and habitat values. The main issue is increasing disturbance on the reservoir to waterfowl and the nesting Peregrine Falcons (or potentially White-bellied Sea-eagles) from yachts. A conservation management plan is required for the Red Ironbarks.

MANAGEMENT

Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. An intact habitat link to the Round the Bend Cooperative–Maroondah Aqueduct site, Watsons Creek to Christmas Hills site, Watsons Creek Upper Reaches–Yarra Ridge site and Yering Gorge–Yering Flats site.

Site 62 Yering Gorge–Yering Flats

This site lies outside the area covered by the five NEROC councils but has been included within the study area of North East Melbourne. Systematic fauna and habitat surveys were conducted. Due to contractual and time constraints the texts on fauna and management have not been written. Assessment keys on habitat and faunal significance and fauna lists are presented. The keys provide a systematic checklist of relevant biological significance parameters to enable comparisons with neighbouring sites in the Yarra Lowland Hills. Site boundaries are shown on Map 1.

Map Reference: 7922 512261 to 7922 535285 (Yarra River from south end of Yering Gorge to 1 km downstream of Victoria Road); 7922 528275 (Yering Backswamp). One minute lat/long grids include 37° 39' x 145° 20', 37° 40' x 145° 19' to 145° 20' and 37° 41' x 145° 19' to 145° 20'.

Municipality: Shire of Nillumbik (north of Yarra) and Shire of Yarra Ranges (south).

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Manna Gum (riverbank) riparian forest (5.1; north bank below No. 6 Tunnel); Narrow-leaf Peppermint herb-rich foothill forest (6.2; north escarpment below No. 6 Tunnel); Swamp Paperbark swamp scrub (17.1); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5); Common Reed–Cumbungi seasonal wetland (25.7); Blunt Pondweed permanent wetland (26.1); 17.1–26.1 each at Yering Backswamp

Relatively intact and extensive stands: Manna Gum (floodplain terrace) riparian forest (5.2); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Messmate–Swamp Gum gully woodland (10.2); Red Box escarpment woodland (13.3); Muttonwood riparian scrub (18.1); Golden Wattle cliff/escarpment shrubland (20.4)

Partially intact or small stands: Manna Gum (riverbank) floodplain riparian woodland (16.4); Swamp Gum swampy woodland (27.1)

Vulnerable species: Spotted Duckweed

Rare species: Stream Club-sedge, Austral Lady's Tresses, Yarra Gum, Showy Willow-herb

Critical assemblages or populations: Riverine Floodplain Critical Conservation Area at Yering Backswamp and cliff/escarpment shrubland and riparian scrub at Yering Gorge. The conservation status of the Yering Gorge to Yering Backswamp section is listed Category 1 due to it supporting six reference stand habitats and a very high diversity of regionally significant plant species (over 90 including 14 regionally endangered species, 10 of which are the only known occurrences in NEM). The area is not fully searched and additional species (including VROTs) are likely present. The habitat significance is listed very high on the basis that the stands of swamp scrub (17.1), seasonal wetland (25.5 and 25.7) and permanent wetland (26.1) at Yering Backswamp are the most intact and representative known to remain in NEM.

The humid conditions at Yering Backswamp support disjunct and regionally threatened plants and animals of biogeographic significance from eastern Victoria. These include the Austral Lady-fern of cool temperate mountain rainforest and Basket-grass of warm temperate rainforest (the latter 250 km from nearest known occurrences in East Gippsland). The regionally vulnerable grass cicada (*Diemeniana frenchi*) is also present. This species breeds in Sword Tussock-grass. The Quaternary sands of the Yarra Fault support coastal heath species (e.g. Soft Bog-sedge and Red-beaks) while semi-aquatic plant alliances show affinities with inland riverine plain (e.g. Giant Rush and Coarse Milfoil) and sub-tropical elements (e.g. Swamp Millet and Floating Bur-reed).

FAUNAL SIGNIFICANCE: Site 62 Yering Gorge–Yering Flats

Assessment: State—Category 1 (B, D, E); Regional (C, D, E, F)

62^a: 37° 41' x 145° 19'; Yarra River, Yering Gorge/Yering Backswamp

62^b: 37° 42' x 145° 18'; Yarra River at Coldstream West

A. Cited Zoological Significance

State. Yarra River and Little Yarra River site. **Regional.** Watsons Creek Catchment and Yarra Ridge site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 62^a: Baillon's Crake, Barking Owl, Brush-tailed Phascogale, Common Bent-wing Bat, Glossy Grass Skink, Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 62^a: 25 species including the Brown Quail, Australian Spotted Crake, Baillon's Crake, Darter, Australian Pelican, Nankeen Night Heron, Great Egret, Cattle Egret, Black Swan, Chestnut Teal and Australian Shelduck at Yering Backswamp/surrounds on 29 August 1993

h. Bats

Regional. 62^a: 5 species (Lesser Long-eared Bat, Chocolate Wattled Bat and Southern, Little and Large Forest Bats) trapped at Yering Backswamp on 16/17 March 1996

i. Arboreal mammals

Regional. 62^a: 6 species including the Brush-tailed Phascogale, Sugar Glider, Feathertail Glider and Koala spotted between the No. 6 aqueduct tunnel and Yering Backswamp on 5 April 1992

j. Ground mammals

Regional. 62^a: 8 species including the Brown Antechinus, Water Rat, Bush Rat and Swamp Rat at Yering Backswamp on 29 August 1993

k. Frogs

Regional. 62^a: 8 species including the Growling Grass Frog, Victorian Smooth Froglet and Southern Toadlet at Yering Backswamp on 29 August 1993

l. Reptiles

Regional. 62^a: 10 species including the White's Skink, Black Rock Skink, McCoy's Skink and Glossy Grass Skink at Yering Backswamp on 27 September 1993; 6 species including the Black Rock Skink, Southern Water Skink and Lowland Copperhead at Yering Gorge on 12 April 1992

m. Freshwater fish

Regional. 62^a: Short-finned Eel and Southern Pigmy Perch in a reedy lagoon to the north of Yering Backswamp on 27 September 1993

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 62^a: over 160 species

b. Native birds

State. 62^a: over 110 species

c. Native mammals

State. 62^a: 22 species

d. Herpetofauna

State. 62^a: 25 species

e. Freshwater fish

Regional. 62^a: 4 species (*Cm* plus Macquarie Perch and Freshwater Blackfish)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 62^a: 35 species

b. Regionally endangered fauna (R1 species)

Regional. 62^a: 2 species. **Birds:** Tawny-crowned Honeyeater (flowering Rock Correa at Yering Gorge on 12 April 1992) **Butterflies:** Bright-eyed Brown (adult flushed from the larval food-plant, Tall Sedge at Yering Backswamp on 27 January 1994; only record for NEM)

c. Regionally vulnerable fauna (R2 species)

State. 62^a: 10 species. **Birds:** Baillon's Crake, Barking Owl, White-throated Nightjar, Azure Kingfisher (gathering food for young at the backswamp on 27 September 1993). **Mammals:** Brush-tailed Phascogale, Long-nosed Bandicoot, Common Bent-wing Bat. **Reptiles:** ; Glossy Grass Skink (Yering Backswamp on 27 January 1994). **Frogs:** Peron's Tree Frog. **Fish:** Freshwater Blackfish

d. Regionally rare fauna (R3 species)

State. 62^a: 10 species. **Birds:** Australian Spotted Crake, Darter, Collared Sparrowhawk, Little Corella, Pink Robin, Spotted Quail-thrush. **Mammals:** Feathertail Glider. **Reptiles:** Murray River Tortoise (basking on a fallen tree in the river just upstream of Yering pumping station on 8 December 1988), Black Rock Skink (Yering Gorge on 12 April 1992 and exposed rock embankment of Maroondah Aqueduct service track south of No. 6 Tunnel on 29 September 1993, 31 December 1995 and 16 March 1996). **Fish:** Macquarie Perch

e. Regionally depleted fauna (R4 species)

State. 62^a: 13 species. **Birds:** Brown Quail, Buff-banded Rail, Latham's Snipe, Whistling Kite, Peregrine Falcon, Powerful Owl, Australian King-Parrot, Leaden Flycatcher, Bassian Thrush. **Mammals:** Platypus, Swamp Rat. **Reptiles:** White's Skink. **Fish:** Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 62^a: 19 species. **Birds:** Brush Bronzewing, Pied Cormorant, Australian Pelican, Nankeen Night Heron, Great Egret, Cattle Egret, Australian Shelduck, Little Eagle, Australian Hobby, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** Common Long-necked Tortoise, Bougainville's Skink, McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 62^a: Wedge-tailed Eagle (Manna Gum stick-nest near Yering Backswamp on 29 August 1993; pair circling overhead); Powerful Owl (bred in spring 1993 in a hollow in a giant Manna Gum at Yering Backswamp; 1-3 birds seen on all six visits made between October 1993 and February 1995)

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 62^a: Latham's Snipe (6 at Yering Backswamp on 27 September 1993)

g. Rare/restricted colonial fauna

Regional. 62^a: 2 Common Bent-wing Bats recorded leaving Maroondah Aqueduct No. 6 Tunnel at dusk on 5 April 1992.

Outlook

The farmland lagoons and a strip of at least 100 m on the east/south side of the Yarra should be fenced from livestock. Weed (particularly Tutsan and Blackberry) and riverbank erosion control and revegetation programs should be conducted on both sides of the river. Management of the aqueduct and pumping station land by Melbourne Water is maintaining conservation values.

Management

Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. An intact habitat link to the Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands site, Round the Bend Cooperative–Maroondah Aqueduct site and Sugarloaf Reservoir site. The forests of the site form part of a contiguous foothills link between the Kinglake Ranges and Yarra Lowland Hills. The Yering Backswamp and the gravel quarry and river meander on private land to the south should be acquired as a conservation reserve.

Strategic Habitat Link.

Other Issues

Common Bent-wing Bats at Maroondah Aqueduct No. 6 Tunnel. Excluders (frame of heavy duty chicken wire and suspended plastic strips) were installed in 1966 at tunnel entrances to prevent water fouling by bats. It was thought that insectivorous bats may carry water-borne diseases, a view now unshared by bat scholars. Cave-bats were unable to enter the tunnels while the excluders remained intact, but in recent years, these have deteriorated making the tunnels partially accessible.

The ceiling of No. 6 Tunnel is formed of native rock. Other tunnels are apparently unsuitable (e.g. No. 5. Tunnel which is brick-lined). The native rock tunnels supported large numbers of bats in the 1960s. Similar to drives in mines, bats roosted in the arches of ceiling rock-joints (John Seebeck pers. comm.). At the request of MMBW (now Melbourne Water) prior to installation of the excluders, some 2000 Common Bent-wing Bats and 20 Large-footed Myotis were removed from the no. 10 Tunnel below Maroondah Dam on 5 July 1966.

Approach should be made to Melbourne Water to consider at least partial removal of the excluders from No. 6 Tunnel as it offers a secure and potentially significant roost-site. Only a few bats roost in the tunnel as the present holes in the wire are too small to enable comfortable passage for bats. An even gap across the top 20–30 cm wide with no jagged wire endings should be sufficient.

Planning Recommendations

Riverine Floodplain Critical Conservation Area (Yering Backswamp). The proposed CCA occupies the west side of the Yarra River and includes the area between the Maroondah Aqueduct and the river from the gully below Tunnel No. 6 exit to the northern gravel quarry, approximately 800 m north-east of Tunnel No. 6 entrance. This includes the ingrown river meander, southern gravel quarry and Yering Backswamp. Swamp Paperbark swamp scrub is possibly the most heavily cleared and degraded habitat in NEM. Near Melbourne and throughout Victoria it is mostly confined to relict stands. The only intact stand in NEM occurs at Yering Backswamp. This lies parallel with the Yarra, between two old gravel quarries. The wetland occurs on Melbourne Water land and has been protected from livestock grazing since the commissioning of Maroondah Aqueduct in 1889 (Jeff Johnstone pers. comm.). Due to poor access, it was probably not grazed prior to this, a land-use history unique in the Yarra Valley and probably the lowlands of Victoria.

There are several other successional backswamps and terrace floodplain wetlands in the CCA which are partially degraded by grazing, clearing or quarrying. Each is predominantly of native vegetation in various stages of repair/revegetation. Under appropriate management and habitat restoration works including rabbit, weed and erosion control, the CCA has potential to become the one of the most significant riverine floodplain swamp systems in Victoria. The scientific reference and geomorphological significance of the river terrace/backswamp system is very

high. Further land clearing, gravel quarrying or livestock grazing in the CCA should not be permitted. The area should remain closed to general public access. The cleared floodplain farmland on the east side of the river is important for waterfowl and ibis. Fencing and revegetation of the river frontage to this area is recommended.

YLH D WATSONS CREEK LOWER REACHES

This management unit consists of one site of state faunal significance (site 64) and one site of regional faunal significance (site 63) and surrounding land that forms habitat links.

Map Reference: 7922 469256 to 7922 517317 (Watsons Creek).

Location/Size: The lower section of Watsons Creek valley and adjacent hill catchments. Part of Watsons Creek Catchment and Yarra Ridge site (Mansergh *et al.* 1989). Approximately 1100 ha.

Municipality: Shire of Nillumbik.

Physical Features

The southern end of the Mt Beggary syncline, which comprises the younger and higher Devonian Kinglake Surface, enters the north of the unit in the Ridge Road/Simpson Road area. This gives way progressively to Silurian sandstone near Watsons Creek township, to the older siltstone/mudstone of the Warrandyte section of the Yarra River. Watsons Creek is a young, actively forming stream. As it leaves the upland hills it changes direction from north–south (away from the uplifted Yarra Ridge which lies to the south-east) to east–west until it approaches the Kangaroo Ground ridge (St Andrews anticline) which re-orientates the lower section back to north–south.

Landforms

Foothill: ridges, hill-crests, hill-slopes, quartz-diorite volcanic plugs, valleys, gullies, creeks and dams. Elevation is 50–215 m (Ridge Road).

Hydrology

Watsons Creek (upstream of Sugarloaf Creek) is ephemeral, running eight or nine months a year. In summer this section contains dry stretches, broken by shallow pools. This section was probably once perennial but now suffers acute ‘dewatering’ due to upstream farm dams. The Sugarloaf and Stevenson creeks are perennial seepage lines from the Sugarloaf Reservoir, carrying between them approximately 4 ML a day. The quality of the seepage water from Sugarloaf Reservoir appears poor and in combination with an increased pattern of land-use in the middle reaches has led to water salination and pollution (see Regional Hydrological Strategy). The creek water downstream of Watsons Creek township is odorous and contains mild algal blooms, which is unusual given the relatively low density of settlement (compared to Diamond Creek) in the catchment. This is apparently due to septic tank outfall and an inadequate creek flow.

Rainfall: 670–740 mm.

Site 63 Henley Road to Watsons Creek

- Map Reference:** 7922 469256 to 7922 462292. One minute lat/long grids include 37° 40' x 145° 14' to 145° 16' and 37° 41' x 145° 14' to 145° 16'.
- Location/Size:** Watsons Creek and local catchments between the Oxley Bridge and the Eltham to Yarra Glen Road bridge. Approximately 640 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Public Land Water Frontage (K1, LCC 1977). Apart from a section of 400 m, downstream of the Eltham–Yarra Glen Road, Watsons Creek streamway and Fryers Gully downstream of Nicholas Lane, is K1. Private: bushland remains only along the creek and drainage lines and in the steep country lying to the east of the creek. The remainder has been heavily cleared. The cleared land forms larger (20–40 ha) cattle and horse grazing properties and some smaller (generally 8 ha) farmlets.
- Landforms:** Foothill (see YLH D). Elevation is 50–180 m.

Scientific and Educational Values

Scientific reference. Electrofishing sites and instream reference points in Watsons Creek at Oxley Bridge and the Eltham–Yarra Glen Road.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference stands: nil

Relatively intact and extensive stands: Manna Gum (creek) riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Red Stringybark box–stringybark woodland (11.3); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Manna Gum (floodplain terrace) riparian forest (5.2); Messmate gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1)

Rare species: Yarra Gum

Critical assemblages or populations: Strategic Habitat Link; critical in the movements of animals along the Yarra–Kinglake link

Notable features: High quality grassland remnants of Yellow Box–Candlebark valley forest occur along the south side of the Maroondah Aqueduct easement west of Calwell Road and on the north side of the easement south of Henley Road; bushland on the south side of the Eltham–Yarra Glen Road, opposite Dawson Road

FAUNAL SIGNIFICANCE: Site 63 Henley Road to Watsons Creek

Assessment: Regional—Category 2 (C, D, E)

63^a: 37° 40' x 145° 14'; Eltham–Yarra Glen Road at Dawson Road

63^b: 37° 40' x 145° 15'; Watsons Creek, Westering Road to Eltham–Yarra Glen Road

63^c: 37° 41' x 145° 14'; Maroondah Aqueduct/Nicholas Lane

63^d: 37° 41' x 145° 15'; Watsons Creek, Calwell Road/Sugarloaf Creek

63^e: 37° 42' x 145° 15'; Watsons Creek at Oxley Bridge on Henley Road

A. Cited Zoological Significance

Regional. Watsons Creek/Yarra Ridge site: Mansergh *et al.* (1989)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

i. Arboreal mammals

Regional. 63^b: 4 species including the Koala and Sugar Glider upstream of Westering Road on 5 April 1992

j. Ground mammals

Regional. 63^b: 6 species including the Long-nosed Bandicoot, Black Wallaby and Bush Rat upstream of Westering Road on 5 April 1992

k. Frogs

Local. 63^c: 5 species including the Victorian Smooth Froglet and Growling Grass Frog in a 20-minute frog count between the east end of Maroondah Aqueduct Tunnel No. 3 and Nicholas Lane on 5 April 1992

l. Reptiles

Regional. 63^b: 7 species including the Tree Dragon, Delicate Skink, Weasel Skink and Lowland Copperhead in a 30-minute timed herpetofauna search under the Candlebarks upstream of Westering Road, north of Sugarloaf Creek on 24 October 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 63^b: over 70 species

b. Native birds

Regional. 63^b: over 50 species

c. Native mammals

Regional. 63^b: 15 species

d. Herpetofauna

Regional. 63^b: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 63^b: 6 species

c. Regionally vulnerable fauna (R2 species)

Regional. 63^b: 3 species. **Birds:** Chestnut-rumped Heathwren, Fuscous Honeyeater. **Mammals:** Long-nosed Bandicoot

Regional. 63^e: 1 species. **Birds:** Blue-winged Parrot

d. Regionally rare fauna (R3 species)

Regional. 63^b: 2 species. **Birds:** Collared Sparrowhawk, Pink Robin

e. Regionally depleted fauna (R4 species)

Local. 63^b: 1 species. **Birds:** Bassian Thrush

e. Regionally restricted fauna

Local. 63^b: 6 species. **Birds:** Brush Bronzewing, Olive Whistler, Red-browed Treecreeper. **Mammals:** Koala. **Reptiles:** Delicate Skink. **Frogs:** Southern Toadlet

Local. 63^d: 2 species. **Birds:** Barn Owl. **Mammals:** Koala

Outlook

Faunal values have declined due to inadequate land protection practices. They would improve with conservation management of the streamway. This should be considered essential to maintain the viability of mountain fauna populations in Warrandyte State Park.

FAUNA

Please note. Time limitations prevented extensive survey (e.g. mammal trapping). The site was originally lumped with the upstream section of Watsons Creek (site 64). It was split off for two reasons. First, it is clearly of lower significance than the upstream section and it would be inconsistent with the study approach for other sites to broadly upgrade this area to the higher level of the other site. Even with full survey, the site would be unlikely to attain state faunal significance. Second, from a management point of view, it is important to highlight this section of the Yarra–Kinglake Conservation Link as it requires strategic protection and conservation works.

Other Significant Fauna

Birds

- Ec* **63^e: Blue-winged Parrot.** They were seen on the grassy flats adjacent to Watsons Creek upstream of Oxley Bridge in the late 1980s (Frank Pierce pers. comm.). This is the only sighting in the Yarra/Nillumbik Hills. They pass through NEM (seen moving over the Plenty Gorge) in April during a migration from the coast to the inland.
- Ec* **63^b: Chestnut-rumped Heathwren.** Pair in dense Burgan, Black Wattle, Sweet Bursaria and Austral Bracken under regenerating Red Stringybark herb-rich foothill forest (6.1) on a sheltered hill-slope east of Watsons Creek, downstream of the Eltham–Yarra Glen Road on 20 August 1990. This was the only lowland observation in NEM. Most sightings of the heathwren (Kinglake NP) have been in post-fire regrowth. Calling males are conspicuous in the breeding season. This male was calling from a perch on the top of fallen wattle branches. On approach, he ran along the branches before dropping into the undergrowth. A domed nest of interwoven grass and twigs was located deep within a Sweet Bursaria. The female had been sitting on eggs.
- Ec* **63^b: Fuscous Honeyeater.** Two birds were seen in Messmate–Mountain Swamp Gum gully woodland (10.2) on the floodplain of Watsons Creek, near the Sugarloaf Creek bridge upstream of Westering Road on 20 August 1990. They are rare winter visitors to NEM, mostly seen in Red Ironbark woodland. The flowering Mountain Swamp Gums attracted an array of honeyeaters. The most common was the White-plumed Honeyeater. Crescent and White-eared Honeyeaters were also present.
- Ed* **63^b: Collared Sparrowhawk and Pink Robin.** Both were seen in Manna Gum riparian woodland (5.3) downstream of the Eltham–Yarra Glen Road on 20 August 1990. The sparrowhawk was hunting through the canopy of the Manna Gums. Two Pink Robins were searching for litter insects on the ground under the Silver Wattles. The robins are mountain visitors, where they breed in the rainforest gullies. Both species are reliant on the habitat link along the creek connecting the mountains and the Yarra.
- Ee* **63^b: Bassian Thrush.** One was seen foraging under dense Burgan in Red Stringybark herb-rich foothill forest (6.1) above Watsons Creek about 500 m downstream of the Eltham–Yarra Glen Road bridge on 20 August 1990. They rake over the damp litter in search of invertebrates, particularly crustacea and molluscs. The thrush may be a mountain visitor to these parts. It is possible that it was a resident.
- Ee* **63^b: Olive Whistler and Red-browed Treecreeper.** The whistler was seen downstream of the Eltham–Yarra Glen Road bridge in Messmate–Swamp Gum gully woodland (10.2) on 20 August 1990. This mountain visitor winters in lowland gullies. The gully woodland stand also supported a pair of Red-browed Treecreepers. Both species are reliant on the habitat link along the creek connecting the mountains and the Yarra.
- 63^b: Rufous Fantail.** On a visit on 24 October 1990, the migratory Rufous Fantail was seen nesting in the Burgan under the Candlebarks (valley forest; 31.1) near Watsons Creek upstream of Westering Road.

Mammals

Ec **63^b: Long-nosed Bandicoot.** Diggings have been located by this author and Peter Homan near Watsons Creek upstream of Westering Road, in Manna Gum riparian forest (5.3) and Yellow Box–Candlebark valley forest (31.1).

Ef **63^{bd}: Koala and other mammals.** A Koala was heard on 5 April 1992 in Fryers Gully (Messmate–Swamp Gum gully woodland; 10.2) near the confluence with Watsons Creek at Calwell Road. Another was heard the same evening upstream of Westering Road (Manna Gum riparian forest; 5.3). This section of Watsons Creek is important to the Koala population along the Yarra in Warrandyte State Park. It is one of few dispersal routes free of busy roads and risk from cars. The mammal fauna along the creek is relatively diverse. Ten species (4 arboreal and 6 ground species) were observed in the section upstream of the Calwell Road bridge while spotlighting on 5 April 1992. The large Manna Gums contain a healthy Sugar Glider population. Bats were common, with three species being identified by spotlight. A Bush Rat was seen in the Sword Tussock-grass–Tall Sedge flats along the creek. The Brown Antechinus is also probably present. Both species are rare in Warrandyte State Park.

Freshwater fish

63^e: Electrofishing Survey: Watsons Creek–Eltham–Yarra Glen Road Bridge

Map reference. 7922 462292. **Altitude.** 70 m. **Survey date.** 13 April 1992 and 7 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum (creek) riparian forest (5.3; fair condition). Frontage: Manna Gum (terrace) riparian forest (5.2; poor condition); Messmate–Mountain Swamp Gum gully woodland (10.2; poor condition); Yellow Box–Candlebark valley forest (31.1; poor condition).

Physical Features:

Pools

Substrate. Deep silt, logs, branches, leaves and urban refuse on sheet mudstone; log jams at downstream end of pools

Maximum size (mid-autumn). 4.0 m wide by 1.3 m deep by 30 m long

Riffles

Substrate. Gravel, pebbles, cobbles and sand on sheet mudstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 3.0 m wide by 10 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 14.3 ML/day

Water quality

Autumn: Temperature. 14.6°C. **Conductivity.** 2500 ms. **Salinity.** 1.5 ppt. **Turbidity.** High

Winter: Temperature. 10.3°C. **Conductivity.** 850 ms. **pH.** 7.4. **Dissolved Oxygen.** 9.9 ppm.

Turbidity. Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (2); migratory sub-adult

Alien species numbers/status. Roach (109; 59 electrofished and 50+ seen); likely breeding resident

Other comments. A small weir to downstream would be sufficient to block the movement of some migratory fish species (e.g. Common Galaxias). Land tenure: road reserve and freehold bushland strip fronting farmland.

63^d: Electrofishing Survey: Watsons Creek–Oxley Bridge on Henley Road

Map reference. 7922 469257. **Altitude.** 45 m. **Survey date.** 13 April 1992 and 7 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum riparian forest (5.3; fair condition). Frontage: Red Stringybark herb-rich foothill forest (6.1; fair condition); Yellow Box–Candlebark valley forest (31.1; fair condition).

Physical Features:

Pools

Substrate. Some silt, rocks, branches and logs on sheet mudstone; log jams at downstream end of pools; channel partly scoured

Maximum size (mid-autumn). 4.0 m wide by 1.6 m deep by 40 m long

Riffles

Substrate. Gravel, pebbles and cobble on sheet mudstone

Flow (autumn normal): Size. 1.0 m wide by 8 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 7.5 ML/day (totally seepage from Sugarloaf Dam)

Flow (mid-winter normal): Size. 1.5 m wide by 20 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 26.7 ML/day

Water quality

Autumn: Temperature. 14.0°C. **Conductivity.** 600 ms. **Salinity.** 0 ppt. **Turbidity.** Cloudy

Winter: Temperature. 10.4°C. **Conductivity.** 475 ms. **pH.** 7.79. **Dissolved Oxygen.** 10.6 ppm. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (10); migratory sub-adult

Alien species numbers/status. Roach (12); likely breeding resident. Brown Trout (1); breeding fish run from the Yarra; fingerlings live in Watsons Creek

Other comments. Given the volume of clear water in the creek there were surprisingly few fish present. Freshwater Blackfish inhabit the deep holes at the creek mouth (Wendy Henderson pers. comm.). Land tenure: roadside reserve and freehold bushland and farms.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. An intact riparian habitat link between the Watsons Creek to Christmas Hills site and Jumping Creek–Stane Brae–Yarra Brae–Bend of Islands site and an overland link to the Round the Bend Cooperative site. The site is part of the only contiguous riparian habitat link between the ranges and the lowland plains in NEM. Its protection is critical for faunal movements between these areas.

Insufficiently wide riparian vegetation strip. The riparian link is narrow throughout, becoming weed invaded and being taken over by Bell Miners. Mountain Swamp Gums on the floodplain and Swamp Gums along adjacent gullies are undergoing dieback as a result of activity of the miners. See the Watsons Creek to Christmas Hills site and the Watsons Creek Upper Reaches–Yarra Ridge site.

Strengthen strategic habitat link. Revegetating the full width of Watsons Creek streamway and preventing further fragmentation of forest habitat between Kinglake and the Yarra will be necessary to maintain populations of most forest species in the site. The site's vital role as a habitat link requires it to be protected.

Revegetating strategic areas of farmland to provide a fuller link with Kinglake National Park is a high priority. Under current management the population viability of many fauna species within the site is declining. It is crucial to revegetate the streamway as the site is the 'weak link' in the Watsons Creek system.

The continued viability of the fauna and the importance of the sites it connects hinge around the viability of faunal movement through this site. Clearing and degradation of streamway vegetation must be prohibited. Revegetating the entire streamway would enhance the significance of the sites that the link connects. This is particularly relevant to the population viability of damp forest fauna species (e.g. Powerful Owl, Red-browed Treecreeper, Eastern Whipbird, Long-nosed Bandicoot and Yellow-bellied Glider) along the Yarra River.

Require increased amount of viable habitat and habitat links throughout the site. The amount of significant habitat remaining in the site (particularly for ground flora and fauna species) is close to a critically low threshold for maintaining many rare or sensitive species (e.g. orchids and ground marsupials such as Long-nosed Bandicoots). All remaining habitat must be protected.

Regional Hydrological Strategy

Electrofishing site at Eltham–Yarra Glen Road bridge:

- high summer–autumn turbidity, siltation, conductivity and salinity rates
- chronically depleted summer-autumn flow rate
- roadway above east bank.
- small farm with cleared paddocks above west bank.
- some nutrient enrichment
- inadequate native instream cover
- some bank erosion—slumping, gulying and tree undercutting
- weed invasion
- dieback of Swamp Gums caused by habitat fragmentation and increased populations of Bell Miners.

Electrofishing site at Oxley Bridge—Impact of the Sugarloaf Reservoir/Winneke Treatment Plant complex.

Periodic release of coloured/odorous water from the complex occurs. There are reports of discharges of both red and green coloured, moderately odorous water in the creek. Constant flows of fast running water, especially in uniform watercourses where distinct channels occur (such as in this site) provide a minimum of habitat for stillwater fish (e.g. Freshwater Blackfish) and instream invertebrates (Koehn & O'Connor 1990). Sudden and unseasonal fluctuations in water volume and level and temperature changes harm native fish. Species affected include the Southern Pigmy Perch, which spawns in quiet shallow water over grasses and twigs; the Mountain Galaxias, which spawns under cobbles in the running riffles; and the Freshwater Blackfish, which often spawn in shallow water or close to the surface where eggs and larvae must remain for more than four weeks (Cadwallader & Backhouse 1983). The sudden release of water can dislodge eggs or displace fry into unfavourable situations (e.g. Yarra River where predatory species are abundant).

Work required on revegetation of the

streamway. The entire streamway (100 m either side of the creek) requires fencing and intensive conservation management. This would improve the riparian ecosystem and water quality of the stream and would provide a necessary strengthening of the Watsons Creek habitat link. The highest priority for funding and resource allocation should be given to this task. Sections of the creek contain the minimum riparian strip fronting farmland. Sections in greatest need include the link between the Candlebarks on Westering Road at Sugarloaf Creek and the bushland south of the Eltham–Yarra Glen Road that was surveyed and found to contain significant orchids and birds on 20 August 1990 (see fauna).

Require improvement in water quantity and quality of creek.

Watsons Creek contains the most significant instream fauna of all second order streams in NEM. Any further farm and bush dam development in the catchment will equate directly to loss of instream values. Stream flow rates commensurate with the conservation of freshwater fish and other instream fauna species need to be determined and re-established (e.g. through strategic release of water from dams during the minimum flow period from February to April).

Monitoring and control of septic tank leachate would be essential to maintain native instream fauna populations. This site contains the lowest density of houses in the lowland hills of NEM. The stream ecosystem is already stressed, and if left to deteriorate further has the potential to decline to the level of urban streams such as the lower reaches of the Diamond Creek and Plenty River (i.e. close to ecosystem collapse). The present viability of the ecosystem would not sustain further housing/effluent production in the catchment.

Oxley Bridge. Bank degradation from human activities. Severe bank erosion—slumping, gullyng and undercutting—has occurred. Worm digging by anglers under the bridge has enhanced the erosion and general creekside degradation and weed advance.

Acquisition of the Watsons Creek Nature Conservation Link. The LCC Melbourne Area 2 final recommendations designated Watsons Creek as a Nature Conservation Link. The aim was to establish a conservation link (park) between the Yarra River, One Tree Hill and Kinglake NP. Implementation of the nature conservation link is one of the highest conservation priorities under the Regional Hydrological and Habitat Link Strategies of this study. Much of the land is already Public Land Water Frontage. Remaining land is under the ownership of Melbourne Water, purchased with public money as part of the Little Watsons Creek Reservoir buy back scheme (see site 64 and Appendix 4.3).

Protection of the Watsons Creek streamway. This is defined as a strip 100 m wide to either side of the creek banks. Disturbances such as earthworks, land clearing, roadways and houses within this strip are viewed as being detrimental to the aquatic and riparian ecosystems. In certain instances, roads and houses exist within the streamway. Disturbances arising from these should be reduced. New developments should be subject to strict permit conditions and be accompanied by a full Environmental Impact Assessment.

Watsons Creek is the most important riparian faunal corridor and habitat link in NEM. The areas that it supports are the Warrandyte State Park and the Yarra Valley Park. The importance of these areas is unquestioned. The population viability of species that are highly valued in these parks is dependent on maintaining habitat links to other population centres. These species include the Powerful Owl, Olive Whistler, Eastern Whipbird, Red-browed Treecreeper, Platypus, Yellow-bellied Glider, Long-nosed Bandicoot and Broad-finned Galaxias. These parks have now become isolated on most fronts by urban encroachment and land clearing. Most other habitat links have become irretrievably fragmented. Watsons Creek is critical to the survival of these animals near Melbourne.

Oxley Bridge. Alien fish—Roach and Brown Trout. Brown Trout and Roach have eliminated the Mountain Galaxias from the lower reaches of Watsons Creek. These and the mainstream Redfin and Macquarie Perch have likely eliminated the galaxias from the lower reaches of all of the tributaries and backwaters of the Middle Yarra.

Public Land Water Frontage. Most of the creek frontage within the site is designated Public Land Water Frontage. The width of the water frontage varies from 20 m to 60 m, some of which has been reserved for public purposes under the *Land Act 1958*. The managing agency is the Department of Natural Resources and Environment. This department must move to control the level of habitat degradation and loss occurring along Watsons Creek frontage. Some of the frontage may be held by adjoining landowners under licence, which requires them to control noxious weeds and vermin on the frontage and prohibit the entry and grazing of livestock to all areas except designated crossing and watering points. Licence conditions on water frontage usage need review with regard to conservation utility and practices such as revegetation.

Monitor discharges and altered flow rates arising from Sugarloaf Reservoir/Winneke Treatment Plant.

Control Brown Trout and Roach populations.

Conservation Measures for Other Issues

Development of a linear trail. The Nature Conservation Link will be a 'green web' park. Present State Government open space policy is to develop linear trails along green webs. The development of a linear trail system along Watsons Creek has merit (e.g. off-road pony trails, nature trail and trail guide) but will need careful planning. If a trail system can be developed which has minimal environmental impact, it might be considered at the periphery of the streamway. The trail should be built on existing cleared land and not bushland. The land would be part of a revegetation area and it would be of utmost importance, for example, for horse riders to keep to the formed track. Strictly enforced trail ride guidelines would need to apply. If these guidelines cannot be carried out or enforced, the option for its closure must be maintained.

Conservation covenanting of private land adjoining the Kinglake–Yarra conservation link and land-owner incentive scheme. The streamway and adjoining bushland along Watsons Creek must receive increased conservation management (see also the Watsons Creek to Christmas Hills site) if the link is to function adequately in the movement of fauna. The linking and compatible management of all gully, box–stringybark and grassy woodland stands on private land through land protection and revegetation programs is considered essential. Covenants would require specific, conditional and pro-active clauses regarding the protection of fauna and faunal habitat values. The purpose and benefits of covenanting should be promoted to all bushland property owners within the site. Incentives and government assistance should be provided to undertake these activities. To reiterate—the entire streamway (100 m either side of the creek) requires fencing and intensive conservation management. This would improve the riparian ecosystem and water quality of the stream.

Formation of a community land protection group. There is great need for a group which can focus management activities on Watsons Creek.

Native vegetation clearance controls on private land. Clearing and degradation (including livestock grazing) of stands of native bushland on private property in the site and any bushland within the streamway of the site should be restricted. Land-use which is in conflict with this proposal should be accompanied with an Environmental Impact Assessment. Without satisfactory conservation measures, all clearing applications should be refused. This may be essential to protect flight corridors and foraging areas for the Common Bent-wing Bat and habitat links for the Powerful Owl and Broad-finned Galaxias.

Site 64 Watsons Creek to Christmas Hills

- Map Reference:** 7922 469256 to 7922 462292. One minute lat/long grids include 37° 39' x 145° 16' to 145° 18'.
- Location/Size:** Watsons Creek and local catchments between the Eltham–Yarra Glen Road bridge and upstream of the Five Mile Creek confluence. Approximately 600 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Public Land Water Frontage (K1, LCC 1977). With the exception of a section of 500 m downstream of One Tree Hill Road, the entire length of Watsons Creek is K1 (NRE); PPP 18–Watsons Creek Dam Reservation (Melbourne Water). This land extends over the proposed catchment of the Little Watsons Creek Reservoir. The site forms the local bushland catchment of Watsons Creek upstream of Watsons Creek township. This land was purchased in the early 1970s by Melbourne Water for the proposed Little Watsons Creek Reservoir. It contains a narrow native vegetation link along Watsons Creek. The central section (Happy Valley/Simpsons Road) backs to either side onto large blocks of bushland owned by Melbourne Water; this and Watsons Creek, is zoned Nature Conservation Link (LCC Melbourne Area 2 final recommendations). The bushland has been protected from subdivision for two decades and contains relatively low density settlement and highly significant vegetation. The cleared land adjoining the site contains (generally 8 ha) farmlets adjoining larger (20–40 ha, or in the case of Waneroo, several hundred hectares) cattle and horse grazing properties.
- Landforms:** Foothill (see YLH D). Elevation is 75–215 m.

Natural Heritage Values

Landscape. The most intact foothills streamway landscape in NEM. Proposed Foothills Streamway Critical Conservation Area.

Scientific and Educational Values

Scientific reference. Electrofishing sites and instream reference points in Watsons Creek upstream and downstream of Happy Valley ford.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Manna Gum (floodplain terrace) riparian forest (5.2); Manna Gum (creek) riparian forest (5.3); Narrow-leaf Peppermint herb-rich foothill forest (6.2); each along Watsons Creek upstream of Clintons Road

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Stringybark box–stringybark woodland (11.3); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Messmate herb-rich foothill forest (6.3); Messmate–Mountain Swamp Gum gully woodland (10.2); Red Ironbark box–ironbark woodland (12.1); Yellow Box–Candlebark grassy woodland (14.6)

Rare species: Yarra Gum

Critical assemblages or populations: Strategic Habitat Link; critical in the movements of animals along the Yarra–Kinglake link. Foothills Streamway Critical Conservation Area (Watsons Creek): the most intact lowland stream in GM. Bushland to either side of Simpsons Road, particularly for orchids

Notable features: High quality grassland remnants of Yellow Box–Candlebark grassy woodland along the cuttings of the Eltham–Yarra Glen Road

FAUNAL SIGNIFICANCE: Site 64 Watsons Creek to Christmas Hills

Assessment: State—Category 3 (B, C, E, F); Regional (C, D, E, F)

64^a: 37° 39' x 145° 16'; Watsons Creek

64^b: 37° 39' x 145° 17'; Watsons Creek, Simpsons Road/Happy Valley confluence

A. Cited Zoological Significance

Regional. Watsons Creek/Yarra Ridge site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 64^b: 8 species. Powerful Owl, Masked Owl, Brush-tailed Phascogale, Common Bent-wing Bat, Broad-finned Galaxias, Mountain Galaxias, Freshwater Blackfish, Yellow-spot Jewel butterfly

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

State. 64^b: 12 species including the Brush Cuckoo, Sacred Kingfisher, Leaden Flycatcher, White-winged Triller and Masked Woodswallow at Happy Valley ford on 9 December 1988

h. Bats

Regional. 64^b: 7 species, including two Common Bent-wing Bats trapped at Happy Valley ford between 28 November and 2 December 1989

i. Arboreal mammals

Regional. 64^b: 4 species including the Sugar Glider and Koala at Happy Valley ford on 9 December 1988. 4 species including the Feathertail Glider and Sugar Glider at Happy Valley ford on 5 April 1992

j. Ground mammals

Regional. 64^b: 5 species at Happy Valley ford on 9 December 1988; 4 species including the Platypus, Brown Antechinus, Long-nosed Bandicoot and Bush Rat at Happy Valley ford on 28 November 1989

k. Frogs

Regional. 64^b: 6 species including the Victorian Smooth Froglet at Happy Valley ford on 9 December 1988

l. Reptiles

Regional. 64^b: 6 species including the Tree Dragon and Lowland Copperhead at Simpsons Road on 18 September 1993

m. Freshwater fish

Regional. 64^b: Short-finned Eel, Broad-finned Galaxias and Freshwater Blackfish electrofished at Happy Valley ford on 13 April 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 64^b: over 90 species

b. Native birds

Regional. 64^b: over 70 species

c. Native mammals

Regional. 64^b: 20 species

d. Herpetofauna

Regional. 64^b: 16 species

e. Freshwater fish

Regional. 64^b: 4 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 64^b: 21 species

b. Regionally endangered fauna (R1 species)

Regional. 64^b: 1 species. **Birds:** Masked Owl

c. Regionally vulnerable fauna (R2 species)

State. 64^b: 7 species. **Birds:** White-throated Nightjar, Azure Kingfisher. **Mammals:** Brush-tailed Phascogale, Long-nosed Bandicoot, Common Bent-wing Bat. **Fish:** Broad-finned Galaxias, Freshwater Blackfish

d. Regionally rare fauna (R3 species)

Regional. 64^b: 5 species. **Birds:** Collared Sparrowhawk, Pink Robin, Masked Woodswallow. **Mammals:** Feathertail Glider. **Butterflies:** Yellow-spot Jewel

e. Regionally depleted fauna (R4 species)

Regional. 64^b: 8 species. **Birds:** Powerful Owl, Leaden Flycatcher, Eastern Whipbird, White-winged Triller, Bassian Thrush. **Mammals:** Platypus. **Fish:** Mountain Galaxias. **Butterflies:** Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 64^b: 11 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Cough. **Mammals:** Koala. **Reptiles:** McCoy's Skink, Delicate Skink. **Frogs:** Southern Toadlet

g. Nesting birds of prey/parrots

Regional. 64^a: Wedge-tailed Eagle (bred in a Yellow Box above Watsons Creek in 1994–95)

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 64^b: Freshwater Blackfish electrofished on 13 April 1992

m. Regionally rare fauna (R3 species)

Regional. 64^b: 5 pair of Masked Woodswallows breeding near Happy Valley ford on 9 December 1988

n. Regionally depleted fauna (R4 species)

Regional. 64^b: 3 Platypus recorded in a dusk survey of Watsons Creek from Clintons Road upstream to the carpark on 18 September 1993

Outlook

The faunal significance, particularly the instream fauna, is declining under current land management. This would improve with enhancement of the riparian link, a move considered essential to maintaining the viability of damp forest fauna populations in Warrandyte SP.

FAUNA

Rare or Threatened Fauna

Bc **64^b: Masked Owl and Powerful Owl.** These two species are the largest of the Victorian owls. Both were recorded in Manna Gum riparian forest (5.3) along Watsons Creek near the confluence of Happy Valley Creek on 5 April 1992. The Masked Owl was summoned by a playback tape of a calling bird from a walkman late in the evening. They are rare and secretive and their call is seldom heard. Like their noisier cousin from the mountains, the Sooty Owl, they avoid areas of human habitation. If a Masked Owl is present and in the mood, it will respond to the call. Occasionally it will fly in and land nearby on an overhead branch, peering angrily and hissing and twittering at the intrusion, as this dark phase, female bird did.

Watsons Creek is important for owls and birds of prey in general. The dense vegetation along the creek provides an abundance of ringtails and Sugar Gliders, while rabbits and Bush Rats are plentiful in the grassy openings under the forest. Shortly after sighting the Masked Owl, a Powerful Owl silently glided between the Silver Wattle canopy and the towering Manna Gums overhead and plucked a ringtail from a wattle. The Powerful Owl is known to breed nearby at Happy Valley in the One Tree Hill site. The riparian link and surrounding woodland and forest is crucial for these owls.

Bc **64^b: Brush-tailed Phascogale.** Two dead male Brush-tailed Phascogales were located in Red Box–Red Stringybark box–stringybark woodland (11.1) to the south of the Eltham–Yarra Glen Road in 1992/93 (Sue Apted pers. comm.).

Bc **64^b: Common Bent-wing Bat.** Two females were trapped under Manna Gum riparian forest (5.3) along Watsons Creek downstream of Happy Valley Creek on 2 December 1989. One was heavily pregnant and the other was a juvenile. The One Tree Hill Mine at the head of Happy Valley is a large roost site for bent-wing bats. At this time of year, females leave the winter roosting sites for their maternity caves in far away places such as East Gippsland. Creeks are important foraging areas for the species, possibly critical for females to build up food reserves before migrating to the maternity colonies. It is also possible that at least for the first part of their journey, they travel down Happy Valley, and then along the riparian route of Watsons Creek to the Yarra.

Bc **64^b: Broad-finned Galaxias.** This species is listed as rare in Victoria. One was recorded in a long, shallow gravel-bottom pool in Watsons Creek during the electrofishing survey on 13 April 1992. The pool supports adult breeding habitat and the fish for most of their lives apart from a period when the fry develop in coastal waters. Five or six adults (about 20 cm long) had been seen in the same pool in late November 1989. The stream supports Manna Gum riparian forest (5.3). The species was not recorded elsewhere in NEM during the electrofishing survey.

Watsons Creek contains small, slackwater pools with low, undercut banks and stretches of clear running water and riffles. The galaxias can take cover if required around submerged logs and rocks or amongst tree roots under bank overhangs. The creek contains dry stretches or stranded channels on the floodplain which are inundated on high water. It provides intact riparian vegetation and ample terrestrial and instream food supply and substrate habitat for shelter, gravel and cobble areas for spawning.

The Broad-finned Galaxias is distributed along coastal drainages of south-eastern Australia. The bulk of the species mainland Australian range occurs in Victoria, the Yarra Basin being one of the more important areas. They inhabit small, slow-flowing rocky creeks with shallow pools and riffles in the foothills and similar habitats in association with cascades in faster water in the ranges. Their distribution is strongly correlated with areas of diverse stream substrate structures (e.g. sand, gravel, cobbles and tree debris) and dense bank cover of riparian forest, scrub thickets and herbfield.

Broad-finned Galaxias are migratory and are able to ascend to pools in ephemeral mountain streams which are inaccessible to other migratory galaxias. They achieve this by several physical adaptations. The pectoral fins are broad and large and face downward. These and the pelvic fins provide support and create a suction over a large surface area of damp substrates. Upward motion is attained by wriggling movements of the whole body or by jumping short distances. Near vertical ascents of 30–40 m have been recorded on damp, rock-faces and waterfalls (John Koehn pers. comm.).

The eggs are laid and fry hatch after autumn rains in the adult habitats and are taken to the river estuaries and possibly out to sea by the high water flows (Koehn & O'Connor 1990). In late spring they return up the streams as six-month-old juveniles (glassy whitebait), when the warming waters peak in food productivity. They spend the next 18 months or so in the lower and middle sections of streams. At two years they reach upstream breeding areas, where they may live as reproductive adults a further two to three years.

As they approach reproductive maturity, Broad-finned Galaxias develop a mottled dorsal and lateral body pattern to blend in with their shaded stream environment. They have a high reproductive output and a single gravid female is capable of laying up to 20 000 eggs. The breeding cycle depends on precise and highly synchronised seasonal water flow events. The trigger for spawning is autumn flash flooding. The eggs are laid communally in the inundated floodwater cobbles and riffles above low banks (O'Connor & Koehn unpub. data). They develop out of water for a minimum of 48 hours (aestivating if longer) in the damp riparian substrate and dappled sunlight provided under the shrub gallery. The eggs rapidly hatch with the next flash flood and are washed into the streams. The early-development phase may be an aquatic predator avoidance mechanism (O'Connor & Koehn unpub. data).

Broad-finned Galaxias are opportunistic nocturnal predators of bottom-dwelling aquatic invertebrates (Koehn & O'Connor 1990). These include the larvae of caddis-flies, mayflies and midges. They also take terrestrial invertebrates (e.g. insects and earthworms) alighting, fallen or washed into the water. Fry probably feed on plankton in the warm and productive coastal waters.

Threats to the Broad-finned Galaxias:

- Inadequate stream flow. This is most acute during the late summer-early autumn low flow period when pools overheat and stagnate, often leading to eutrophication and oxygen depletion.
- Increased sediment output into streams due to logging and land clearing. This may fill or cover potential spawning sites and reduce the ability of eggs to adhere to substrates.
- Loss of native riparian vegetation which prevents erosion and provides instream habitat (e.g. logs and branches) and shading as well as important prey items in the form of terrestrial invertebrates.
- High siltation and salinity rates and poor water quality in the lower and middle reaches of streams due to land clearing, livestock grazing and water pollution from agricultural and urban runoff. These have led to loss or degradation of native vegetation and bank and stream bed substrates, each reducing native prey and plant cover abundances. These conditions favour introduced fish species.
- Altered flooding regimes caused by flood mitigation works through the development of river impoundments and weirs and artificial barriers to migration such as reservoir walls.
- Loss of breeding habitat caused by river 'improvements' to lower the incidence of flooding and facilitate more rapid removal of floodwater in urban streams. These activities include channel straightening, levee-banking, de-snagging and clearing of riparian vegetation and reclamation or draining of floodplain swamps and lagoons.
- Predation and food competition from Brown Trout in upper reaches and Roach, Redfin and Mosquito Fish in lower reaches of streams.

Bc/Fb **64^b: Freshwater Blackfish.** This species occupies the drainage systems south of the Great Dividing Range in Victoria. It has declined throughout its range and the conservation status is listed as insufficiently known. The range has been considerably reduced in GM and they have been eliminated from the lower reaches of most streams and elsewhere have become rather localised. A viable population was recorded in Watsons Creek during the electrofishing survey on 13 April 1992, but this will require effective protection if it is to be maintained. The stream supports Manna Gum riparian forest (5.3). Blackfish are unable to withstand heavy angling pressure, partly owing to their slow maturation and low breeding and juvenile survival rates. It is critical that angling not be permitted in this section of Watsons Creek.

Freshwater Blackfish inhabit a range of waters from shallow pools in fast-moving mountain streams to reservoirs and deep pools in slow-moving lowland rivers. Pools need to be permanent, of reasonable size and more than 0.5 m deep at their driest time. Blackfish require well-oxygenated pools with at least moderate water quality. These contain intact substrate and banks, ample native instream and riparian vegetation cover and submerged logs, tree roots or rocks.

Blackfish spawn on rising water temperatures in late spring and early summer (Koehn & O'Connor 1990). They have a slow growth rate to sexual maturity and low reproductive output. Nest sites are located in the territory of the male and are carefully chosen by the female. The large, adhesive, yolky eggs (usually 50 to 300) are attached in a single layer to the inside of hollow logs or in rock crevices. Eggs fail to hatch when blanketed by silt, hence the male fans them. He also guards the eggs and hatchlings from fish and invertebrate predators. Rising turbidity and siltation in streams has been a major factor influencing their decline.

Blackfish are nocturnal carnivores, preying on aquatic invertebrates, particularly those living around logs and in the mud substrate. They feed by laying in a concealed situation in waiting for passing prey. These include insects (e.g. caddis-fly and mayfly larvae and beetles), crustaceans, worms and molluscs. They also take terrestrial insects that have been swept into the stream and occasionally other fish.

The main threats to blackfish in local streams is habitat loss and decline in water quality through increased siltation and pollution arising from land clearing and settlement. Other threats include loss of water flow due to damming and draining of floodplain marshlands and river improvement schemes such as clearing of submerged snags for improved flow and flood mitigation.

Bc **64^b: Yellow-spot Jewel butterfly.** An adult and a pupa were located on Hazel Pomaderris in Manna Gum riparian forest (5.3) near Watsons Creek on 2 December 1989. Adults, pupae and eggs were located in late December 1995 (Fabian Douglas pers. comm.).

Critical Assemblages or Populations

Cf **64^b: High diversity of breeding migratory canopy insectivores at Happy Valley ford.** Twelve species including the Brush Cuckoo, Sacred Kingfisher, Leaden Flycatcher and White-winged Triller were breeding on 9 December 1988 near the Happy Valley Creek confluence. Habitats along Watsons Creek and adjoining sheltered escarpment and valley included Manna Gum riparian forest (5.3), Narrow-leaf Peppermint herb-rich foothill forest (6.2) and Yellow Box–Candlebark grassy woodland (14.6). Five pair of Masked Woodswallows were breeding in twig nests among forks in Silver Wattles.

Other Significant Fauna

Birds

- Ec* **64^b: Azure Kingfisher.** One was seen in Manna Gum riparian forest (5.3) downstream of Happy Valley Creek on 13 April 1992. The bird dived and took from the water surface a Roach that had been stunned by the electrofisher. The kingfishers are mostly seen at this time of year in NEM. They are apparently mostly non-breeding visitors from places unknown.
- Ed* **64^b: Collared Sparrowhawk.** A pair bred in Manna Gum riparian forest (5.3) along Watsons Creek in November 1989. The sparrowhawk was frequently seen along this section of the creek during the survey.
- Ee* **64^b: Eastern Whipbird.** A pair bred in Manna Gum riparian forest (5.3) along Watsons Creek in late November 1989 in the undergrowth along the creek, near a breeding pair of Rufous Fantails, just downstream of Happy Valley ford. Whipbirds no longer breed along the Yarra River. Populations from Watsons Creek, move downstream during autumn–winter. Whipbirds do not cross open country and are reliant on riparian links during the winter movements into the lowlands from the hills and ranges. Any further fragmentation along the Watsons Creek link may prevent them from visiting the Middle Yarra. As well as habitat link fragmentation, they suffer acutely from predation from cats and competition from Common Blackbirds.
- Ef* **64^b: Brush Bronzewing.** A substantial population occurs in the Manna Gum riparian forest (5.3) along Watsons Creek.
- Eg* **64^a: nesting Wedge-tailed Eagle.** Since 1989, a pair of eagles have bred in a huge Yellow Box in a stand of partially cleared Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes above Watsons Creek. A pair bred in Happy Valley until disturbed by motor bikes and shooters in 1985. A pair which bred on the Yarra at Stane Brae moved away from that area in the late 1980s. With future breeding of the Chase (Stony Creek North Warrandyte) birds problematical due to housing encroachment, the Watsons Creek birds are one of the last nesting pairs in the Yarra Lowland Hills.

Mammals

- Ec* **64^b: Long-nosed Bandicoot and ground mammal trapping along Watsons Creek.** Trapping was conducted in Manna Gum riparian forest (5.3) downstream of Happy Valley Creek from 28 November to 2 December 1989. The Bush Rat, Brown Antechinus and Long-nosed Bandicoot were recorded. Diggings of the latter were observed amongst the Spiny-headed Mat-rush and Common Maiden-hair just upstream of Watsons Creek on the banks of Happy Valley Creek. A line of ten large cage traps was set in the area. The bait was the usual mixture of peanut butter, rolled oats and honey, but with a dose of peppermint essence. One bandicoot and several brushtail possums were trapped. The bandicoot was trapped on only four other occasions during the study. The Long-nosed Bandicoot has a keen sense of smell which is used for locating a favoured food, underground fungi, which occur on the sheltered hill-slopes of Happy Valley Creek.
- Ed* **64^b: Feathertail Glider.** One was seen in the dense Silver Wattles under Manna Gum riparian forest (5.3) along Watsons Creek upstream of Happy Valley Creek on 5 April 1992.
- Ee* **64^b: Platypus.** Three were recorded in a dusk survey of Watsons Creek from Clintons Road upstream to the carpark on 18 September 1993. Single animals were seen in the creek at Happy Valley ford on 2 December 1989, 5 April 1992 and 23 August 1992. Vegetation of the creek bank was Manna Gum riparian forest (5.3). That Platypus are resident and breeding in this section of the creek is evident from the frequency of sightings and the location of an active burrow downstream of the ford., although lack of summer–autumn flow caused by upstream farm dams is a limiting factor.

Breeding populations have been eliminated from the lower sections of the Diamond and Arthurs creeks and Plenty River over the last two decades (similar to the Freshwater Blackfish in these streams). This supports the statement that Watsons Creek is the most significant second order stream for instream vertebrate fauna in NEM. It is likely that during the winter flood and turbidity peaks of the Yarra, Platypus enter the backwaters of Watsons Creek.

Populations of Platypus are declining in the lower Yarra River system. There are possibly several contributing reasons for this. These include elimination of native vegetation through urban advance and past farming activities, stream modifications, widespread bank degradation resulting from disturbance, advance of weeds, the presence of large populations of introduced fish (food competition) and the overall poor water quality (excessive pollution and turbidity levels). In the early years, significant numbers were shot or trapped for pelts or drowned in fish traps. The banks and riparian vegetation along the Yarra at the mouth of Watsons Creek and upstream along Watsons Creek are some of the most intact in the lowlands of NEM. The intact substrates and relatively unpolluted water of Watsons Creek determines the availability of invertebrate food supplies on which the Platypus and native fish depend.

- Ef* **64^b: Koala.** They were seen on two occasions in Manna Gum riparian forest (5.3) along Watsons Creek. The creek forms their main path between Warrandyte and Kinglake. At Happy Valley Creek, some move overland through the One Tree Hill site, while others continue along Watsons Creek.

64^b: Bat trapping along Watsons Creek. Trapping was conducted under Manna Gum riparian forest (5.3) along Watsons Creek downstream of Happy Valley Creek from 28 November to 2 December 1989. Bats had been seen previously in the area but over four successive nights of trapping, none were obtained. On the fifth night, seven species were caught, the most frequent being the Chocolate Wattled Bat and Southern Forest Bat. The Common Bent-wing Bats was also trapped (see *Bc*).

Freshwater fish

- 64^b: Electrofishing Survey: Watsons Creek—downstream of Happy Valley Creek

Map reference. 7922 491315. **Altitude.** 100 m. **Survey date.** 13 April 1992 and 7 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged herbfield. Bank: Manna Gum riparian forest (5.3; good condition). Frontage: Manna Gum (floodplain terrace) riparian forest (5.2; poor condition); Narrow-leaf Peppermint herb-rich foothill forest (6.2; excellent condition); Messmate–Mountain Swamp Gum gully woodland (10.2; poor condition); Yellow Box–Candlebark grassy woodland (14.6; fair condition)

Physical Features:

Pools

Substrate. Silt, logs, leaves and car debris on sheet mudstone; bank undercuts; log jams at downstream end of pools. The creek contained a chain of pools and dry cobble sections

Maximum size (mid-autumn). 3.0 m wide by 1.0 m deep by 20 m long

Riffles

Substrate. Gravel, pebbles, cobbles and sand on sheet mudstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 1.0 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 4.8 ML/day

Water quality

Autumn: Temperature. 15.3°C. **Conductivity.** 5300 ms. **Salinity.** 5.0 ppt (saline). **Turbidity.** Cloudy; partly of lignin from the substrate eucalypt leaves

Winter: Temperature. 10.6°C. **Conductivity.** 2775 ms. **pH.** 7.89. **Dissolved Oxygen.** 10.4 ppm. **Turbidity.** Cloudy; muddy runoff from nearby disturbed ground

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (4); migratory sub-adult. Broad-finned Galaxias (1); likely breeding resident; early stage of life-cycle spent in saltwater. Freshwater Blackfish (1); likely breeding resident

Alien species numbers/status. Roach (111; 61 electrofished and 50+ seen); likely breeding resident

Other comments. Fishing should not be permitted. The Freshwater Blackfish would be locally eliminated by even low angling pressure. Land tenure: council reserve/roadway and Melbourne Parks and Waterways. Five Broad-finned Galaxias were seen in the pool in October 1989.

64^b: Electrofishing Survey: Watsons Creek—upstream of Happy Valley Creek

Map reference. 7922 493315. **Altitude.** 100 m. **Survey date.** 13 April 1992 and 7 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged herbfield (dense growth of Lake Milfoil). Bank: Manna Gum (creek) riparian forest (5.3; excellent condition). Frontage: Manna Gum (floodplain terrace) riparian forest (5.2; good condition); Narrow-leaf Peppermint herb-rich foothill forest (6.2; excellent condition); Messmate–Mountain Swamp Gum gully woodland (10.2; fair condition); Yellow Box–Candlebark grassy woodland (14.6; fair condition)

Physical Features:

Pools: (same as downstream of Happy Valley Creek)

Riffles

Substrate. Gravel, pebbles, cobbles and sand on sheet mudstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 1.0 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 4.8 ML/day

Water quality

Autumn: Temperature. 18.0°C. **Conductivity.** 5000 ms. **Salinity.** 4.2 ppt (saline). **Turbidity.** Clear

Winter: Temperature. 10.6°C. **Conductivity.** 2100 ms. **pH.** 7.77. **Dissolved Oxygen.** 10.13 ppm. **Turbidity.** Cloudy

Fish Recorded During Survey

Native species numbers/status. Freshwater Blackfish (2); likely breeding resident

Alien species numbers/status. Roach (6); likely breeding resident

Other comments. The blackish resided amongst car bodies in the creek. The Mountain Galaxias and Short-finned Eel were recorded in pools downstream of Christmas Hills Primary School in October 1989.

Butterflies

64^b: **Watsons Creek at Happy Valley Creek.** Incidental observations of significant species on 2 December 1989. The Blue Jewel was observed flying near some Black Wattles under Yellow Box–Candlebark

grassy woodland (14.6) by the Eltham–Yarra Glen Road verge, just upstream of the Happy Valley picnic area. A substantial breeding colony of the Common Imperial Blue was located in dwarf Silver Wattles under Yellow Box–Candlebark grassy woodland (14.6) between the creek and the road.

MANAGEMENT

Threatening Processes	Conservation Measures
The Little Watsons Creek Reservoir/Lower Yarra Scheme (see Appendix 4.1).	
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. An intact riparian habitat link between Watsons Creek–Yarra Ridge site and One Tree Hill site via Happy Valley Creek and downstream via the Henley Road to Watsons Creek site to Warrandyte SP. The site forms one of the most crucial faunal corridors in NEM as it provides the most intact and contiguous riparian habitat link between the ranges and the lowland hills. Its role in the movements of fauna species from the Kinglake Ranges to the Yarra Lowland Hills is considerable.</p>	
<p>Fragmentation of forest habitat between Kinglake and the Yarra.</p>	<p>Strengthen strategic habitat link. More effective linkage will prevent further fragmentation of forest habitat between Kinglake and the Yarra. The vital role of the site as a habitat link requires that it be protected. Revegetating strategic areas of farmland to provide a fuller link with Kinglake NP is a high priority. Bushblocks within the site of significance containing substantially intact ground flora should be protected from livestock grazing. Despite less than adequate conservation management, the population viability of most of the fauna species within the site is still reasonably secure. That of damp forest fauna species (e.g. Powerful Owl, Red-browed Treecreeper, Eastern Whipbird and Long-nosed Bandicoot) will require monitoring and habitat enhancement. The instream fauna require immediate conservation action.</p> <p>Foothills Streamway Critical Conservation Area. (see also Melbourne Open Space, Green Web below) Watsons Creek is the most natural second order stream in NEM. The section occurring in the site is the most significant lower order stream in the foothills and contains the most intact lowland riparian forest vegetation in NEM. It is critical for the survival of the Platypus, Freshwater Blackfish and Broad-finned Galaxias. It is consequently the proposed Foothills Streamway Critical Conservation Area in NEM.</p>

Regional Hydrological Strategy

Overview. The full development of this strategy for Watsons Creek is viewed as a critical priority for the Shire of Nillumbik. The presence of the Broad-finned Galaxias and Freshwater Blackfish meant the section at Happy Valley Creek was determined as the most significant for fish of the 52 electrofishing survey sites in NEM. The riparian habitat link was also found to be one of the most significant for terrestrial fauna in NEM. A public land link from Warrandyte State Park to Kinglake National Park is proposed. Disturbed public access areas will need soil rehabilitation, weed control and revegetation works. Due to insufficient supply of late summer-autumn flow, no further farm dams should be permitted in the catchment. A system of released water at these critical periods from some of the larger dams should be investigated. The reasons for the high salinity/conductivity levels of the water should also be investigated. Sources of water pollution should be monitored and controlled. Stock access to tributaries such as Five Mile Creek and Reedy Creek should be prevented by fencing.

Declining water quality. The water of Watsons Creek may be partly contaminated with heavy metals from dumped cars and the old operations of the One Tree Hill mine (e.g. cyanide and mercury were both used in the early on-site battery crushing and sluicing operations). Poultry, pig, cattle and horse farms, stock access to feeder streams and gullies and domestic wastewater and leachate from septic tanks in the catchment may be contributing to nutrient enrichment of the stream.

Declining water flow due to clearing and farm dams. There is a depleted summer–autumn stream flow rate. Extensive clearing in the middle catchment (e.g. Waneroo) may be the source of the high conductivity/salinity levels of the water. The inadequate summer flow is a direct consequence of too many farms dams in the catchment. Land subdivision in the catchment would entail more dams. Low rainfall where it rises in Kinglake NP creates a relatively low natural flow rate, but the effect of dams has led to an acute shortage of supply in late summer–autumn.

Public Land Water Frontage. Most of the creek frontage within the site is designated Public Land Water Frontage. The width of the water frontage varies from 20 m to 60 m. Some of this was reserved for public purposes under the *Land Act 1958*. The primary conservation purposes of the Public Land Water Frontage are to:

- protect adjoining land from erosion by the maintenance of an adequate vegetation cover
- maintain the local character and quality of the landscape
- conserve native flora and fauna
- provide opportunities for low-intensity recreation

The managing agency, NRE, must move to control the level of habitat degradation and loss occurring along the Watsons Creek frontage. Some of the frontage may be held by adjoining landowners under licence. Licence holders are required to control noxious weeds and vermin on the frontage.

The main conclusion to be drawn from the viable populations of native fish recorded in Watsons Creek and varying results from average to dismal from elsewhere in the Shire of Nillumbik is the fact that the catchment has a far lower density of housing. Impact from land settlement on the creek ecosystem has been substantially lower. Noteworthy is the rapid decline in water quality and native instream fauna downstream of the junction of Long Gully Creek (which drains the rural/residential area of Panton Hill). If the fish and Platypus are to remain in the upper section, further housing development needs to be restricted.

Public access and recreational activities along the streamway. The Eltham–Yarra Glen Road follows much of the south bank of Watsons Creek, leading to rubbish dumping and off-road vehicle access problems. Bank erosion (slumping, gullyng and undercutting), is severe in the downstream sections where the river valley is farmed. Weed invasion, particularly Blackberry and Montpellier Broom, has been enhanced by the bank disturbance. Until being gated at the Eltham–Yarra Glen Road, the grassland area between Happy Valley ford and the Eltham–Yarra Glen Road was used as a ‘hot car quagmire’. Heavy rain washed the mud directly into the section of the creek where the Platypus, Freshwater Blackfish and Broad-finned Galaxias live. The sandy beaches downstream of the ford became silted and sludge up to 10 cm thick developed in the pools. This would have affected some of the prey of the Platypus and Broad-finned Galaxias such as caddis-fly larvae, which are dependent on clear, well-oxygenated water. It would also have reduced the viability of blackfish eggs.

Roach, Brown Trout and the declining native galaxias. The Mountain Galaxias was one of the most widespread native fish in NEM. A decade ago they were common in the pools at Happy Valley ford. Roach were not present. The arrival of the Roach has eliminated the Mountain Galaxias from downstream of Happy Valley Creek. They have been recently seen in only one section upstream (behind the Christmas Hills Primary School). Roach have recently crossed to upstream of the ford. They established in the second and third order streams of NEM in the early 1980s. There is little information on their predation and competitive effects on small-stream native fish such as the Mountain Galaxias. The Roach is also coming into contact with the galaxias in the middle reaches of the Diamond and Arthurs Creeks and Plenty River. Based on what occurred in Watsons Creek, they may eliminate the galaxias.

No recreational fishing in this section of Watsons Creek. The creek supports the only remaining viable population of Freshwater Blackfish in a lowland second order stream in NEM. Fishing should not be permitted in any section of the stream contained in the site as this would deplete and possibly eliminate the blackfish.

The turbidity level of the stream caused by runoff from the main road and upstream farmland and tracks is already high enough to stress these animals, such is the delicate balance of instream ecosystems. The damage to the grassy flats at the entrance of Happy Valley is now under repair.

Control of Roach and Brown Trout populations in Watsons Creek. Measures to reduce the populations of these introduced predators appear necessary if the native galaxias are to survive.

Loss of flow due to farm and bushblock dams has affected the Mountain Galaxias and Freshwater Blackfish. Water pollution, loss of flow and removal of streamway and valley vegetation has decreased all native fish. The Mountain Galaxias is considered potentially threatened in the lowlands of NEM due to habitat loss and inferior water quality. It is being eliminated by Brown Trout in the Yarra River and in the upper reaches of the Plenty River and Arthurs Creek. The fry of the sedentary Mountain Galaxias are vulnerable to predation and even the adults (generally 6-8 cm long), are taken by Roach (several electrofished in Watsons Creek were over 30 cm long). Mountain Galaxias and Roach seldom coexist. This is a major concern given the importance for the galaxias of the upper reaches of streams in NEM such as the Plenty River and Diamond Creek. The Roach was not recorded, but may establish in both.

Water salinity. The pollution input and high water salinity level must be of concern to the proposed downstream siting of the Little Watsons Creek dam. The high salinity of Watsons Creek may partly be the reason for the elimination of the Mountain Galaxias. The Broad-finned Galaxias is tolerant of higher levels of water salinity, even in its freshwater life cycle (Koehn & O'Connor 1990). The source of the salinity is possibly the groundwater. The groundwater of Silurian bedrock characteristically contains high levels of sodium salts. The release of groundwater salts into the creeks is a natural occurrence. The presence of high levels in Watsons Creek has been caused by catchment land-clearing (e.g. Waneroo) and the reduction of freshwater flow with the proliferation of dams.

Runoff from Yarra Glen Road. Heavy metal runoff from the road and silt from the bare road embankments would contribute to the high water conductivity. Oil-contaminated runoff also enters the stream from the road and pools have an oil slick in late summer. There is inadequate native instream vegetation cover in downstream sections.

About 500 m downstream of the Happy Valley ford the creek comes close to the road. A culvert drain under the Yarra Glen Road takes the runoff into the creek at a point where broken riffles leave a deeper pool upstream (containing the Platypus) and enter a shallower pool downstream (containing the Broad-finned Galaxias).

Pollution monitoring and point source control in Watsons Creek. All point pollution sources of the creek need to be identified and their output reduced (in accordance with the Regional Hydrological Strategy). Four instream reference points have been established in the stream. Water quality testing at these points should be routinely conducted.

Oil-traps for the Eltham—Yarra Glen Road runoff. Oil emission from cars is a problem for small-stream ecosystems throughout lowland Victoria. A system to trap the oil runoff from the Eltham—Yarra Glen Road, preventing it from reaching the creek (perhaps by small retarding basins) should be devised.

Horse riding/walking trails. A linear trail along Watsons Creek will conflict with flora and fauna values. The trail has potential for heavy use and consequently habitat loss and degradation and faunal disturbance.

Development of a linear trail. Present State Government open space policy is to develop linear trails along green webs. Safe horse riding areas away from roads are needed but these require careful planning and should be accompanied by an Environmental Impact Assessment. The proposed Watsons Creek trail must have minimal environmental impact and will need to be located on paddock/farmland areas external to the site of significance. The land would be part of a revegetation area. It would be of the utmost importance for users such as horse riders to keep to the formed track. The approval of trails within designated sites of significance must be accompanied by strictly enforced user guidelines and an environmental monitoring system. Cross-over points within the site must be clearly located (e.g. in areas of minimum impact) and adequately maintained, particularly regarding off-trail incursions and weed invasion.

Require plant protection and vegetation survey. Melbourne Water land adjoining Simpsons and Ridge Road is an important area for orchids. It is part of the proposed Nature Conservation Link and will require specific management for the conservation of orchids. Access to the area should be restricted to research and management. A survey and management plan of the plants and vegetation of this area is required.

Formation of a community land protection group. The Watsons Creek LandCare group has recently formed. This group needs to focus activities in the site on the streamway and riparian corridor and the control of weeds such as Boneseed, Spanish Heath and Montpellier Broom on the hill-slopes and roadsides.

Melbourne Open Space/Green Web—special conservation measures required

The Melbourne Parks and Waterways and Open Space 2000 initiative is developing an open space/green web network from the bay to the ranges. This is primarily along Melbourne's arterial river and radial drainage systems where the main open space network exists. The streamway parklands support the only remaining contiguous areas of native forest habitat and functional faunal corridors in urban NEM. A primary purpose of the open space initiative is to link existing open space in the system to protect/enhance conservation values in areas which are becoming increasingly fragmented by urban growth and development, thereby maximising their environmental, recreational and educational potential. The open space strategy recognises the importance of rehabilitating the streamways and preserving the natural values of the Yarra Valley.

The long-term viability of populations of animals in fragmented blocks improves if they are connected by habitat corridors. The primary purpose of the proposed nature conservation link is to provide a contiguous native forest corridor for the movement of fauna between the Kinglake Ranges and the Yarra River. The proposed corridor needs to be of sufficient width to support viable populations of animals within as well as facilitating the movement of animals between the more substantial areas of habitat along the Yarra and in Kinglake NP that it connects.

Species which are most dependent on faunal corridors include birds dependent on large trees or tree hollows for nesting including parrots and birds of prey, small forest birds particularly honeyeaters, migratory songbirds (insectivores) and shrub layer species such as fantails and whistlers, arboreal mammals including bats and particularly mobile species such as Koalas, ground fauna species but particularly reptiles and small to medium sized mammals (particularly the Platypus and Long-nosed Bandicoot) and freshwater fish. Improved protection of streamway vegetation in NEM would greatly assist the conservation of these species.

Land between Watsons Creek and Christmas Hills was acquired by Melbourne Water in the early 1970s for the proposed Little Watsons Creek Reservoir (see Appendix 4.3). This land forms the bulk of the site and including the Water Frontage Reserve, is proposed as a Nature Conservation Link (LCC Melbourne Area 2 proposed recommendations). The relevant LCC recommendation on p. 84 states that the area:

- i be managed cooperatively by the Department of Natural Resources and Environment and Melbourne Water as a habitat link in accordance with the recommendation for nature conservation reserves (see below)
- ii that cleared or semi-cleared land within the link be revegetated using indigenous species
- iii if the Little Watsons Creek Reservoir proceeds, Melbourne Water ensure that a habitat link around the western side of the storage is maintained
- iv if the Little Watsons Creek Reservoir does not proceed, the Melbourne Water land within the link be transferred to and managed by the Department of Natural Resources and Environment on a basis to be agreed between the two authorities.

Management of the conservation link. The link should be managed to ensure that birds, arboreal mammals, ground fauna and freshwater fish can have ready passage between localised areas, and also are able to traverse the whole link (LCC Melbourne Area 2 proposed recommendations). The level of conservation management proposed for the link is to be comparable to that for a nature conservation reserve. The relevant LCC recommendation on p. 66 for nature conservation reserves states that they:

- i conserve and protect species or communities of indigenous animals and plants
- ii provide for educational and scientific study compatible with (i) above, and in ways which minimally affect the area
- iii should permit passive recreation such as nature study and picnicking by small numbers of people
- iv should not permit grazing, harvesting of forest products, hunting and the use of firearms
- v should not permit exploration for and extraction of earth resources.

Controlled rate of public usage. A nature conservation (biological) reserve is set aside for its natural ecosystem values. It is important that the ecosystem is able to function properly. It cannot be subjected to high levels of disturbance or public use or its integral processes will function inefficiently or break down. Public use will need to be restricted to areas of low environmental sensitivity and this must be limited to passive activities. These must not be near wildflower or revegetation areas (etc.). Of particular concern is disturbance from the Watsons Creek carpark, which is located amongst the most significant riparian vegetation along Watsons Creek, upstream of Happy Valley.

This disturbance requires amelioration. Horse and bike riding and vehicles must be excluded from the native vegetation areas within the site of significance, including roadsides containing significant vegetation (e.g. Ridge Road and Simpsons Road). Disturbance from horse riding leading to weed invasion is already an incremental problem.

Road-killed fauna—road speed restrictions and access tunnels. To facilitate faunal movement along the Warrandyte–Kinglake corridor, tunnels would be required under the Eltham–Yarra Glen Road at strategic fauna crossing points. A fauna road-kill monitoring study should be implemented to ascertain where these areas occur. Animals are killed over the entire length of the site between Long Gully Road and the Christmas Hills Primary School. The traffic speed along this section needs to be restricted (and effectively sign-posted) to 75 km/hour. It has become a major tourist road and safeguards reducing the rate of mortality of native wildlife on these roads have not been sufficiently addressed. An increased traffic density along the road is contrary to the conceptual purposes of the Warrandyte–Kinglake Nature Conservation Link. Further tourist promotion, upgrading for arterial traffic and rural/bushland settlement necessitating an increase in car frequency should be restricted.

The role of the community. The conservation link will require the combined resources of NRE and the local community to deal with some immediate land protection issues such as weed control (particularly Boneseed, Spanish Heath, Sweet Pittosporum, Blackberry, Montpellier and Flax-leaf Broom, Sweet Pittosporum and alien grasses). Most of the bushblocks within the proposed nature conservation link contain a dwelling. These have been let by Melbourne Water since they were acquired. Many tenants have occupied the land for 10 or more years.

If in the event that NRE is inadequately resourced to deal effectively with management, the land occupier workforce and skills would provide an integral support group. Many of the tenants are already members of the Watsons Creek LandCare group. Consideration should be given to retaining the lessees as caretaker land occupiers over an interim period until the decision is made on the Little Watsons Creek Reservoir. The land occupiers would need to comply with the above stated LCC requirements over the land. As an incentive, an option for renewed application in lieu of conservation performance is suggested. Conditions may include:

- i low impact lifestyle with regard to water usage and wastewater and sewage runoff;
- ii participation in conservation works (e.g. boneseed control, revegetation etc.) on the block;
- iii no cats, dogs or domestic animals or agricultural activities;
- iv all activities other than nature study/interpretation, art and conservation management be confined to a designated household area;
- v reduction of the impact of activities and disturbances in the household area on the bushland (e.g. indigenous garden development);
- vii involvement with land-occupier duties such as deterring transgressions from the public (e.g. firewood gathering, native plant removal, particularly orchids and riding);
- viii no removal of firewood (including fallen timber or dead timber), native plants, native animals or earth resources.

Items (ii) and (vi) will be incremental problems in the nature conservation link if NRE cannot provide adequate management resources including constant ranger patrol. New NRE ranger staff will be required. Stretching the already taxed resources of existing staff from Warrandyte would divert essential management away from the state park.

NILLUMBIK LOWLAND HILLS (NLH)

Farmland and bushland catchments of the middle Diamond Creek, lower Arthurs Creek and Long Gully Creek (tributary of the Watsons Creek).

Land-use

Past land-use: pastoral, townships, orchards, firewood and mining. Present land-use: bushland reserves, bushblock and farmlot settlement, townships, urban from Wattle Glen to Hurstbridge and recreation.

Native vegetation cover

Fragmented.

Key biological features

Barking Owl, Regent Honeyeater, Common Dunnart and Brush-tailed Phascogale.

The most significant habitats are valley, riparian and dry sclerophyll forests.

Of particular note are faunal rarity, abundance and diversity and habitat rarity and abundance, Red Ironbark dry sclerophyll forest, and the strategic habitat links between the upland and lowland hills (primarily Long Gully Creek and Diamond Creek).

Key areas/physical features for biota

Dunmoochin and Pittles Paddock, Diamond Creek, Arthurs Creek, Long Gully and Boomers Reserve, Koos Reserve, Red Shirt Gully Creek, Haleys Gully Road Red Ironbarks and Temple Ridge/Orchid Track.

14 sites of significance: 6 state and 8 regional for fauna and 4 very high, 4 high and 6 medium for habitat.

NLH A ARTHURS CREEK HURSTBRIDGE TO STRATHEWEN

This management unit consists of two sites of regional faunal significance (sites 65 and 66) and surrounding land that forms habitat links.

Map Reference: 7922 405336 to 7922 4467427 (Arthurs Creek from upstream of the confluence of Diamond Creek at Midhurst to the confluence of Chadds Creek at Strathewen).

Location/Size: The unit stretches along Arthurs Creek from Hurstbridge to Strathewen. It is centred on the confluence of Arthurs and Running/Deep creeks, just north of Arthurs Creek township. Approximately 900 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. Arthurs Creek forms a broad valley and floodplain at the confluence of Running Creek. The unit marks a meeting point of the gently undulating Plenty Upland Hills (Silurian sandstone) to the west with the steeper and more heavily dissected Nillumbik Upland Hills (Silurian siltstone/mudstone) to the east. The extensive alluvial floodplains of the Arthurs Creek valley provides the dominant landscape feature of the unit.

Landforms

Foothill: ridges, hill-crests, hill-slopes, gullies, valleys, creeks, stream, floodplain and confluence (Arthurs and Running Creek) and dams. Elevation is 70–180 m.

Hydrology

Arthurs Creek is a third order stream, flowing for about nine months in normal years. It would have been perennial prior to settlement. Running and Deep Creek are fourth order streams. Running Creek ran throughout the summer–autumn of 1991–92 with the decommissioning of the Running Creek Reservoir. Arthurs Creek contains cobble and gravel riffles and sand bars. Undercut banks surround open water pools (< 1 m deep in the upper and about 1.5 m in the lower section) with submerged logs and emergent snags. The creek channels are deeply scoured and the banks have undergone severe slumping and erosion. There is a thick layer of silt on the bottom of the pools. The floodplain confluence of Arthurs and Running/Deep creeks was formerly a marshland area of riparian forest and seasonal wetland herbfields of approximately 100 ha. The marshland was cleared, dammed and drained and now only the gullies and small, ephemeral freshwater meadows remain. The local hills have been heavily cleared and sheet and gully erosion has occurred. The silt-laden runoff has been deposited in the confluence area.

After heavy and prolonged rain the floodwaters break over the low creek banks and temporarily inundate the low-lying section of the confluence floodplain with up to 0.5 m of water. Before settlement, the floodwaters backed up over the floodplain for several weeks. In wet years the floodwaters would have remained through the winter/spring months and runoff would have seeped out of the forested hills above Arthurs Creek and fed the floodplain marshland for most of the year. This would have created a large, permanent wetland area, probably important for waterbirds. Floodwaters now disperse in one or two days. The Running Creek Reservoir and large dams in the Strathewen valley and Running Creek valley now probably retain over 70% of the annual flow. They release little water during the summer–early autumn months and the creeks now stop running over this period. This lack of flow is critically affecting the instream ecosystem. There is a weir downstream of the Arthurs Creek Road bridge.

Rainfall: 680–750 mm.

Site 65 Arthurs Creek to Strathewen

Map Reference:	7922 413383 to 7922 467427 (Arthurs Creek from 600 m downstream of Arthurs Creek Road bridge to the Chadds Creek confluence at Strathewen). One minute lat/long grids include 37° 33' x 145° 15', 37° 34' x 145° 12' to 145° 13'.
Location/Size:	The site stretches linearly along Arthurs Creek from Arthurs Creek to Strathewen. The broadest section occurs in the extreme south at the confluence of Arthurs and Running/Deep creeks and contains Arthurs Creek township. Approximately 350 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: Water Frontage (upstream of Eagles Nest Road and a strip from the northern end of the Glen Valley orchards to Strathewen); municipal reserves (e.g. streamway reserve at the Arthurs Creek Road bridge); and Vic Road reservations (e.g. Eagles Nest Road and Cottles Bridge Strathewen Road). Private: farmland (orchards and small livestock and hobby farms in the creek valleys). Broad-acre cattle farms west and the Glen Valley orchards and small farms and bushblocks east of the creek.
Landforms:	Foothill (see NLH A). Elevation is 110–180 m.

Scientific and Educational Values

Scientific reference. Grassy/gully woodland census plot between the Cottles Bridge–Strathewen Road and the corner of Eagles Nest Road and Brennans Road East. Electrofishing site and instream reference point on Arthurs Creek at Eagles Nest Road.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Manna Gum (creek) riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Yellow Box–Candlebark valley forest (31.1); each along Arthurs Creek at Eagles Nest Road and nearby at the corner of the Cottles Bridge–Strathewen Road

Remnant, degraded or establishing stands: Manna Gum (floodplain terrace) riparian forest (5.2); Messmate herb-rich foothill forest (6.3); Messmate gully woodland (10.2); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark grassy woodland (14.6)

Rare flora. Yarra Gum

Notable features: mature Candlebarks over native grassland on the corner of Cottles Bridge–Strathewen Road and Bowden Spur Road; this supports grassy woodland reptiles including the Eastern Three-lined Skink. Arthurs Creek township marks the transition along the floodplain from the lowland Common Tussock-grass/Swamp Gum gully woodland (10.3) alliance to the upland Sword Tussock-grass/Messmate gully woodland (10.2) alliance.

FAUNAL SIGNIFICANCE: Site 65 Arthurs Creek to Strathewen

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

65^a: 37° 34' x 145° 12'; Arthurs Creek, Arthurs Creek township to Eagles Nest Road

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 65^a: Swift Parrot at Arthurs Creek township

c. Rare fauna

Regional. 65^a: Freshwater Blackfish in the pools of Arthurs Creek at Glen Valley orchard

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 65^a: 10 species including the Sacred Kingfisher, Tree Martin, Rufous Songlark and Olive-backed Oriole during the October 1989 and 1990 grassy woodland census

g. Breeding parrots

Regional. 65^a: 6 species including the Gang-gang Cockatoo, Little Corella, Red-rumped Parrot and Crimson Rosella during the October 1990 grassy woodland census

k. Frogs

Regional. 65^a: 6 species including the Victorian Smooth Froglet and Striped Marsh Frog between the junction of Arthurs and Running creeks and Eagles Nest Road on 19 February 1988

m. Freshwater fish

Regional. 65^a: 3 species including the Short-finned Eel, Australian Smelt and Southern Pigmy Perch electrofished from Arthurs Creek at Eagles Nest Road bridge on 14 April 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 65^a: 122 species

b. Native birds

Regional. 65^a: 103 species

c. Native mammals

Regional. 65^a: 5 species

d. Herpetofauna

Regional. 65^a: 10 species

e. Freshwater fish

Regional. 65^a: 4 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 65^a: 16 species

b. Regionally endangered fauna (R1 species)

Regional. 65^a: 1 species. **Birds:** Budgerigar

c. Regionally vulnerable fauna (R2 species)

Regional. 65^a: 3 species. **Birds:** Crested Pigeon. **Fish:** Australian Smelt, Freshwater Blackfish

d. Regionally rare fauna (R3 species)

Regional. 65^a: 3 species. **Birds:** Little Corella, Fork-tailed Swift, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 65^a: 9 species. **Birds:** Australian King-Parrot, Swift Parrot, Rainbow Bee-eater, White-winged Triller, Speckled Warbler, Rufous Songlark. **Mammals:** Platypus. **Frogs:** Bibron's Toadlet. **Fish:** Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 65^a: 11 species. **Birds:** Brush Bronzewing, Australian Pelican, Cattle Egret, Australian Hobby, Long-billed Corella, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

F. POPULATION DENSITY: Viability and Abundance—point census

c. Regionally restricted fauna (R5 species)

Regional. 65^a: 20 Cattle Egrets on the creek flats east of Arthurs Creek primary school on 25 May 1990

Outlook

Long-term severance of habitat links may cause the faunal significance to decline from Regional Category 1 to Category 2. The Swift Parrot has not been seen since the mid-1980s. Species dependent on Arthurs Creek such as the Rainbow Bee-eater, Platypus and Freshwater Blackfish have been affected by streamway degradation and declining water quality.

FAUNA

Rare or Threatened Fauna

Bb **65^a: Swift Parrot.** They have been seen near Arthurs Creek township (Danny Rogers pers. comm.). They are rare visitors to Yellow Box–Candlebark grassy woodland (14.6; mainly for buds and leaf psyllids in early spring) and Manna Gum riparian forest (5.3; mainly for nectar in early autumn).

Bc **65^a: Freshwater Blackfish.** Still occur in the pools by Glen Valley orchard (Joe Shepherd pers. comm.).

Other Significant Fauna

Birds

Ed **65^a: Little Corella.** Breeding in Manna Gum riparian forest (5.3) at Eagles Nest Road and Yellow Box–Candlebark valley forest (31.1) along Cottles Bridge–Strathewen Road in the October 1989 and 1990 bird census transects. The Arthurs Creek valley forms one of the strongholds of the Little Corella in NEM. A pair of Gang-gang Cockatoos also bred in a Candlebark on both years of the census.

Ee **65^a: Eastern Whipbird.** Recorded on 5 July 1992 in Manna Gum riparian forest (5.3) at Eagles Nest Road. They are winter visitors to this section of Arthurs Creek. Prior to land clearing whipbirds would have bred in the site. Since that time a range contraction has occurred. The species is also affected by predation from foxes and cats and competition from Common Blackbirds.

Ee **65^a: Rufous Songlark and Speckled Warbler.** A pair of songlarks bred in a Candlebark at the corner of the Cottles Bridge–Strathewen and Bowdens Spur Road on the Yellow Box–Candlebark valley forest (31.1) census plot in October 1989 and 1990. The warbler was observed at the census transect on 15 and 17 October 1990.

Ef **65^a: Cattle Egret.** A flock of about 20 was seen on the creek flats east of Arthurs Creek primary school on 25 May 1990. This was the first sighting along Arthurs Creek but they have been recorded annually since. Their range has expanded into the floodplains of Arthurs and Diamond Creek from the Plenty Valley.

Ef **65^a: Red-browed Treecreeper.** An isolated and apparently small population persists in Manna Gum riparian forest (5.3) along Arthurs Creek at Eagles Nest Road. The creek lies between the two stages of the grassy woodland census plot. It was visited ten times during the census transects of October 1989 and 1990 and several other occasions during the general survey. The treecreeper was recorded only once (15 October 1990).

65^a: Bird list for Arthurs Creek township. A detailed list was provided by Ken, Annie and Danny Rogers. Cleared farmland predominates along the creek confluence floodplains and valleys and hill-slopes. The forest birds were recorded in remnant stands of Manna Gum riparian forest (5.3). A number of grassy woodland species, such as the Red-rumped Parrot, were recorded in remnant Yellow Box–Candlebark grassy woodland (14.6) in the township area. These are characteristic of the River Red Gum grassy woodland of the Plenty Valley further west. Their main occurrence in the Shire of Nillumbik is along Arthurs Creek.

Significant species

- Brush Bronzewing: along the creek; possibly winter dispersing birds
- Crested Pigeon (pair roosting in the house garden)

- Australian Ringneck: resident and breeding in the stand of large Yellow Box near the Primary School; population derived from aviary escapees
- Australian King-Parrot: occasional autumn-winter visitor from the ranges; occasionally seen in the house garden
- Budgerigar: single bird seen on one occasion; unknown whether an aviary escapee or natural occurrence as they are irruptive visitors to the Merri and Plenty Valley River Red Gum grassy woodlands
- Rainbow Bee-eater: nesting in the banks of Arthurs Creek
- Fork-tailed Swift: seen once overhead; usually over late summer in years when cyclonic activity reaches southern Victoria
- White-winged Triller: rare spring migrant to the grassy woodland
- Speckled Warbler: resident in the Yellow Box grassy woodland above Arthurs Creek, upstream of the Running Creek confluence
- White-browed Woodswallow: rare spring migrant seen in passage.

65^a: Valley forest/gully woodland bird census: Cottles Bridge–Strathewen/Eagles Nest Road. Ten 2 ha/20-minute counts were conducted in October 1989 and 1990. The census consisted of two 500 m stages each 20 m wide (width of roadway). The first (eastern) stage was along the west end of the Cottles Bridge–Strathewen Road and the adjoining section of Bowden Spur Road to Eagles Nest Road. The second (western) stage continued along Eagles Nest Road from Arthurs Creek bridge to Brennans Road East.

Degree of fragmentation: medium (two sides farmland, two sides connected to bushland). The two stages contained a roadside verge amongst blocks of grassy woodland (each of 20 ha). They were separated by farmland along the Arthurs Creek valley. The eastern stage flanked a 100 ha bushblock of Red Stringybark herb-rich foothill forest to the north and a dry creek containing scattered Candlebarks (cleared of shrubland vegetation) to the south. The western stage flanked riparian forest along Arthurs Creek. Degree of thinning: medium (tree density of 160/ha). Degree of understorey and ground degradation: medium (moderately intact road verges; adjacent paddocks and timbered hill-slopes).

Vegetation. Narrow bands of Yellow Box–Candlebark valley forest (31.1) along the roadways. and Manna Gum riparian forest (5.3) at the west end of the transect at Eagles Nest Road bridge on the Arthurs Creek. Red Stringybark herb-rich foothill forest (6.1) flanked the northern (sheltered) side of the Cottles Bridge–Strathewen Road. Trees/ha (20% cover): 75 Yellow Box, 30 Red Stringybark, 25 Candlebark, 15 Long-leaf Box, 10 Narrow-leaf Peppermint and 5 Manna Gum. Tall shrubs (5% cover); low shrubs: (20% cover); herbs (60% cover).

Results. Bird summary: 54 species and 734 individuals recorded (17 forest, 15 woodland, 10 shrubland and 12 fragmentation species); 36.7 birds/ha composed of 11.3 (31%) forest, 8.7 (24%) woodland, 5.6 (15%) shrubland and 11.1 (30%) fragmentation species

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (1.9), Crimson Rosella (1.8), Weebill (1.6), Spotted Pardalote (1.6), Buff-rumped Thornbill (0.7), Rufous Whistler (0.7), Yellow-faced Honeyeater (0.7) and Fan-tailed Cuckoo (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (2.2), Eastern Rosella (1.7), White-plumed Honeyeater (0.8), Tree Martin (0.7), Sulphur-crested Cockatoo (0.5) and Mistletoebird (0.5)

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (2.5), Grey Fantail (0.7), Grey Shrike-thrush (0.6) and Silvereye (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Noisy Miner (3.5), Common Starling (2.9), Australian Magpie (1.2), Common Myna (1.1), Willie Wagtail (0.5) and Little Raven (0.5)

Parrots: 7 species and 5.5 birds/ha. **Canopy insectivores—migratory:** 11 species and 3.8 birds/ha; **non-migratory:** 8 species and 9.6 birds/ha

Discussion. 36.7 birds/ha, 13.4 of which were canopy insectivores (dieback control agents). This is a poor representation of canopy insectivores, particularly the thornbills and cuckoos. This would be attributed to the high population density of Noisy Miners. Shrubland birds, particularly the flycatchers, were poorly represented.

This is attributed to the paucity of shrubland vegetation. However, the Black Wattle along Eagles Nest Road contained the Speckled Warbler. The presence of the two small stands of valley forest, the larger adjoining stand of herb-rich foothill forest and the riparian forest along the creek has influenced the high forest bird count. The clearing of bushland has provided a diverse fragmentation avifauna.

Ten species of breeding migratory canopy insectivores and seven species of breeding parrots were recorded. This was one of the highest counts for each in the 16 census plots. The mature Candlebarks were important for breeding parrots. Open woodland species including the Tree Martin, Rufous Songlark, Red-rumped Parrot and Little Corella were well represented, due to the dominance of Candlebark. These species were rare or absent along Watsons and upper Diamond creeks.

Conclusion. Contiguous habitat on two sides and a partial habitat link along the creek maintains the valley forest avifauna.

Mammals

Ee **65^a: Platypus.** One seen in Arthurs Creek between the Running Creek confluence and Eagles Nest Road on 19 February 1988. Vegetation along the creek is Manna Gum riparian forest (5.3). The species was not recorded on several subsequent visits. The sighting may represent a dispersing individual from upstream or possibly from the Yarra near the mouth of Diamond Creek (see site 35).

Ef **65^a: Koala.** One in Manna Gum riparian forest (5.3) near the Eagles Nest Road bridge on two occasions during the survey. Once on 19 February 1988 and once during the bird census transect of 24 October 1990. Koalas are not regarded as resident along the middle and lower Arthurs Creek or elsewhere in the Nillumbik Lowland Hills. The nearest resident populations are at Smiths Gully and the Sherwin Ranges. They are scarce in the upper reaches of Arthurs Creek. Individuals disperse along foothills watercourses.

Frogs

Ee/Ef **65^a: Bibron's Toadlet and Common Spadefoot Toad.** Both of these plains species were heard calling from the floodplain downstream of the Arthurs Creek school on a rainy May night in 1990. The main range of both in NEM is to the west in River Red Gum grassy woodland on the Plenty Volcanic Plains.

Freshwater fish

Ec **65^a: Australian Smelt.** Arthurs Creek was electrofished at Eagles Nest Road bridge on 14 April 1992 (Raadik in prep.). Four Australian Smelt were sampled and ten others were seen. Australian Smelt were recorded in only one other of the 52 electrofishing sites in NEM. Smelt are tolerant of moderately turbid and saline stream conditions. Six Southern Pigmy Perch and one Short-finned Eel were also taken at Eagles Nest Road. The absence of the Mountain Galaxias, which was taken at all upstream sites and most downstream sites in Arthurs Creek, may be due to a combination of lack of summer flow (caused by upstream dams) and high water turbidity. The large Glen Valley orchards are immediately upstream and runoff would probably contain fertilisers, herbicides and insecticides.

65^a: Electrofishing Survey: Arthurs Creek–Eagles Nest Road

Map reference. 7922 424396. **Altitude.** 115 m. **Survey date.** 14 April 1992

Vegetation. Instream: submerged and emergent herbfield (good condition). Bank: Manna Gum riparian forest (5.3; fair condition). Frontage (west side): Red Stringybark herb-rich foothill forest (6.1; fair condition); Yellow Box–Candlebark valley forest (31.1; fair condition). East side contained cleared floodplain terraces (ex-Manna Gum riparian forest; 5.2).

Physical Features:

Pools

Substrate. Silt, leaves, logs and branches on sheet sandstone; channel scoured

Maximum size (mid-autumn). 6.0 m wide by 1.5 m deep by 20 m long

Riffles

Substrate. Gravel and cobble on sheet sandstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): **Size.** 2.0 m wide by 20 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 38 ML/day

Water quality

Autumn: Temperature. 17.0°C. **Conductivity.** 335 ms. **Salinity.** 0 ppt. **Turbidity.** High

Winter: Temperature. 10.5°C. **Conductivity.** 80 ms. **pH.** 6.58. **Dissolved Oxygen.** 10.2 ppm. **Turbidity.** Cloudy

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel; migratory sub-adult. Southern Pigmy Perch (6); likely breeding resident. Australian Smelt (14); likely breeding resident

Alien species numbers/status. Roach (2); likely breeding resident

Other comments. Land tenure: council reserve and farmland.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Loss of habitat links. This is the most acute threatening process operating on the site. Heavy clearing in the western section for farming has led to high attrition rates of forest fauna species. Clearing and fragmentation of bushland for housing in the eastern section will bring about similar species reductions.</p> <p>Land degradation. As elsewhere in the Silurian terrain of the lowland hills of Victoria, the gullies, hill-slopes and hill-crests have poor land capability and have been degraded by farming practices. Heavy grazing by livestock has caused soil erosion, leading to ground compaction, nutrient-depleted soil and enriched waterways. Remnant bushland areas have become weed invaded.</p>	<p>Habitat connectivity. No effective links are present. A partially fragmented riparian forest link north to the ranges exists along Arthurs Creek. Fragmented woodland links to the Nillumbik Lowland Hills east of Arthurs Creek (e.g. along Shaws Road).</p> <p>Grassy woodland bird census plot at Cottles Bridge–Strathewen/Eagles Nest Road. Further stand fragmentation and thinning and habitat link severance will tip the delicate balance presently operating in favour of fragmentation bird species. Revegetating broken links and broadening the grassy woodland strips will be necessary to maintain the present native forest, woodland and shrubland avifauna populations.</p>
Regional Hydrological Strategy	

**Electrofishing site at Eagles Nest Road—
declining water quality and bank**

degradation. Moderate turbidity/siltation rate. The water is brackish and mildly polluted. Depleted summer-autumn flow rate. Banks have been degraded and have undergone slumping and erosion (tree and bank undercutting and scouring of creek channel) as they have been subjected to long-term livestock grazing. There is a road above the east bank and inadequate native riparian cover. Advancing weeds are willow, Blackberry, Panic Veldt Grass and Cocksfoot.

Electrofishing site at Eagles Nest Road.

Upstream of Eagles Nest Road is a large orchard. Eagles Nest Road forms a significant habitat node and faunal corridor in the local area and bushland flanks either side of the creek (see grassy woodland bird census). To downstream and upstream lie extensive areas of cleared farmland in the creek valley. The riparian vegetation is in most part fenced off, but of inadequate width. Between Eagles Nest Road and the Running Creek confluence is the most important section for native fish in Arthurs Creek to Strathewen section. A fenced strip at least 100 m wide on either side of the creek should be allowed to regenerate. This would enhance the native fish and Platypus populations present. This should be accompanied by the development of a habitat protection incentive scheme.

**Water quality controls and monitoring in
Arthurs Creek.**

Site 66 Hurstbridge to Arthurs Creek

Map Reference:	7922 405336 to 7922 404375 (Arthurs Creek). One minute lat/long grids include 37° 35' x 145° 10' to 145° 11', 37° 36' x 145° 10' and 37° 37' x 145° 11'.
Location/Size:	A linear strip along Arthurs Creek from Midhurst to about 1 km upstream of Chapel Lane, Nutfield. Approximately 500 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: Water Frontage (small strip upstream of Chapel Lane including the Streamside Reserve, 1 km upstream of Chapel Lane; NRE/Shire of Nillumbik); Other Reserve (triangular block between the Hurstbridge–Arthurs Creek Road and Arthurs Creek at Versos Bridge, Midhurst; NRE); and Vic Road reservations (e.g. sections of the Hurstbridge–Arthurs Creek Road). Private: farmland (small livestock and hobby farms). Larger 20 to 80 ha and the 200 ha Brock properties occur west of the creek at Nutfield.
Landforms:	Foothill (see NLH A). Elevation is 70–180 m.

Scientific and Educational Values

Scientific reference. Grassy woodland census plot south of Chapel Lane. Electrofishing sites/instream reference points on Arthurs Creek at Verso's Bridge Midhurst, the Brock property and 1 km upstream of Chapel Lane.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Manna Gum (creek) riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Manna Gum gully woodland (10.1; Stewart Ponds); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark grassy woodland (14.6); Yellow Box–Candlebark valley forest (31.1)

Remnant or degraded stands: Manna Gum (floodplain terrace) riparian forest (5.2; Brocks); Swamp Gum gully woodland (10.3; Doctors Gully)

Vulnerable flora. Matted Flax-lily

Rare flora. Stream Club-sedge, Yarra Gum

Notable features: grassland under Yellow Box–Candlebark grassy woodland on the hill-slope of Doctors Gully on Brocks; the riparian vegetation on the upstream section of Brocks is the most intact along the lower reaches of Arthurs Creek; remnant freshwater meadow of Common Tussock-grass/Tall Sedge (ex-10.3) along lower Doctors Gully at Brocks. Manna Gum and scattered Mountain Tea-tree along Arthurs Creek and Stewart Ponds are remnants of wetter upland areas while the hill-slopes support species of the drier plains (e.g. Curved Rice-flower).

FAUNAL SIGNIFICANCE: Site 66 Hurstbridge to Arthurs Creek

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

66^a: 37° 35' x 145° 11'; Arthurs Creek, upstream of Chapel Lane

66^b: 37° 36' x 145° 10'; Arthurs Creek and Brocks land, Nutfield

66^c: 37° 37' x 145° 10'; Bannons Road North, Nutfield

66^d: 37° 37' x 145° 11'; Arthurs Creek, Midhurst

B. RARITY: Rare or Threatened Fauna

b. Endangered

- Unranked. 66^b:** Regent Honeyeater (last seen in flowering Manna Gums at Lintons Bridge in late February 1978)
- c. Rare fauna
- Regional. 66^b:** Masked Owl, Mountain Galaxias, Freshwater Blackfish
- Regional. 66^d:** Mountain Galaxias, Freshwater Blackfish
- Regional. 66^c:** Rare White-spot Skipper butterfly
- Regional. 66^a:** Mountain Galaxias
- C. DIVERSITY: Species/Assemblage Richness—point census/trapping
- f. Breeding migratory insectivores
- Regional. 66^b:** 8 species during the October 1990 grassy woodland bird census
- g. Breeding parrots
- Regional. 66^b:** 7 species including the Little Corella, Long-billed Corella and Gang-gang Cockatoo during the October 1990 grassy woodland bird census; the aviary escapee, Australian Ringneck, was also recorded
- h. Bats
- Regional. 66^b:** 5 species trapped at Lintons Bridge on 18 December 1990
- D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey
- a. All native vertebrate fauna
- Regional. 66^b:** over 90 species
- b. Native birds
- Regional. 66^b:** over 70 species
- c. Native mammals
- Regional. 66^b:** 8 species including five species of bats and the Water Rat between Lintons Bridge and Chapel Lane
- d. Herpetofauna
- Regional. 66^b:** 10 species at Nutfield
- e. Freshwater fish
- Regional. 66^b:** 4 species at Arthurs Creek Nutfield (Freshwater Blackfish, Mountain Galaxias, Short-finned Eel and Southern Pigmy Perch)
- f. Butterflies
- Regional. 66^b:** 27 species
- E. REPRESENTATIVENESS: Significant Species—reference grid survey
- a. GM critical fauna (R1-R4 species)
- Regional. 66^b:** 16 species
- b. Regionally endangered fauna (R1 species)
- Regional. 66^b:** 3 species. **Birds:** Masked Owl, Dollarbird, Little Friarbird
- Regional. 66^c:** 1 species. **Butterflies:** Rare White-spot Skipper
- c. Regionally vulnerable fauna (R2 species)
- Regional. 66^b:** 2 species. **Birds:** Azure Kingfisher. **Fish:** Freshwater Blackfish
- Regional. 66^a:** 1 species. **Birds:** Hooded Robin
- Regional. 66^d:** 1 species. **Fish:** Freshwater Blackfish
- d. Regionally rare fauna (R3 species)
- Regional. 66^b:** 3 species. **Birds:** Collared Sparrowhawk, Little Corella, White-browed Woodswallow
- Regional. 66^d:** 1 species. **Birds:** White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 66^b: 8 species. **Birds:** Brown Quail, Rainbow Bee-eater, Speckled Warbler, White-winged Triller, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Regional. 66^a: 3 species. **Birds:** Rainbow Bee-eater. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Regional. 66^d: 2 species. **Fish:** Mountain Galaxias, Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Regional. 66^b: 14 species. **Birds:** Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Meadow Argus, Dark Purple Azure, Chequered Blue

Local. 66^a: 2 species. **Birds:** Australian Hobby, Long-billed Corella

Local. 66^d: 2 species. **Birds:** Cattle Egret. **Reptiles:** Delicate Skink

g. Nesting birds of prey/parrots

Regional. 66^b: Wedge-tailed Eagle (Candlebark on a hill-slope above the lower Stewart Ponds Creek in 1991 and 1994); Long-billed Corella (Arthurs Creek at Brocks in October 1989)

F. POPULATION DENSITY: Viability and Abundance—point census

j. Electrofishing rate

Regional. 66^d: 65 fish (60 Southern Pigmy Perch and 5 Mountain Galaxias) at Verso's Bridge Midhurst on 14 April 1992

m. Regionally rare fauna (R3 species)

Regional. 66^{bd}: White-browed Woodswallow (5 pair breeding in Manna Gums at Burkes Bridge on 30 October 1991 and 3 pair breeding in Manna Gums along lower Stewart Ponds Creek on 8 December 1991)

n. Regionally depleted fauna (R4 species)

Regional. 66^a: 20 Rainbow Bee-eaters upstream of Chapel Lane on 13 March 1989

Regional. 66^{ad}: 8 Southern Pigmy Perch electrofished from the Streamside Reserve 1 km upstream of Chapel Lane on 14 April 1992; 60 Southern Pigmy Perch and 5 Mountain Galaxias electrofished from under Verso's Bridge

o. Regionally restricted fauna (R5 species)

Regional. 66^b: 25 Long-billed Corellas feeding on ripened Hawthorn berries near Lintons Bridge on 13 March 1989

Outlook

Unless water quality and habitat links are improved loss of insectivorous birds and dieback will increase. The loss of mature Manna Gums from creek-bank erosion will reduce nesting parrots.

FAUNA

Rare or Threatened Fauna

Ba 66^b: Regent Honeyeater. Recorded in flowering Manna Gum riparian forest (5.3) at Lintons Bridge in late February 1978. They had been seen in the 1970s on two occasions, visiting the flowering Manna Gums in late summer-early autumn. Since 1980 the area has been searched annually and the Regent Honeyeater has not been recorded. The Manna Gums flowered heavily every three to four years in the 1970s and now the period between heavy flowering is six to eight years. Why the flowering fails for such a succession of years is unknown, but it appears to be related to streamway habitat fragmentation.

Bc 66^b: Masked Owl. An adult bird was observed in remnant Yellow Box–Candlebark grassy woodland (14.6) on farmland at Nutfield in June 1990. Areas on the creek escarpments with shrubby understoreys or thickets,

particularly thorny wattles (Hedge Wattle), Sweet Bursaria and bracken, harbour rabbits, their main prey. They were recorded breeding 5 km to the east along Diamond Creek at Cottles Bridge in spring 1994 (site 75). Birds have been recorded nearby at Dunmoochin (site 68) on several occasions.

66^b: Eastern Quoll. They were present on Kiah-kerabee until the 1930s (Geoff Brock pers. comm.). Widespread and common in GM last century, they were extinct by the 1940s except at Yarra Bend, where they survived until the early 1950s.

Bc **66^{bd}: Freshwater Blackfish.** Recorded in Arthurs Creek between Lintons Bridge and Chapel Lane in 1992 (Peter Brock pers. comm.) and more recently downstream at Midhurst (Beverley Brock pers. comm.). A fingerling blackfish was taken in a baited cage trap at Brocks on 15 November 1992.

Bc **66^{abd}: Mountain Galaxias.** Widespread and uncommon along the Arthurs Creek.

Bc **66^c: Rare White-spot Skipper.** There have been only two records of this rare butterfly over the last two decades in GM (Nutfield and Plenty–Janefield, both in NEM). The Nutfield record was from remnant Yellow Box–Red Stringybark box–stringybark woodland (11.2) along Bannons Road North, south of Doctors Gully Road in November 1988 (Nigel Quick pers. comm.). An adult was seen feeding at flowering Common Rice-flower on a road cutting. The larvae feed on Wattle Mat-rush.

Other Significant Fauna

Birds

Eb **66^b: Dollarbird.** A single bird downstream of Chapel Lane in Manna Gum riparian forest (5.3) along Arthurs Creek and in adjoining Yellow Box–Candlebark grassy woodland (14.6) along the Hurstbridge–Arthurs Creek Road on 18 October 1989. Fifty years ago they were annual spring–summer migrants from northern Australia and New Guinea, but are now very rare and infrequently seen. This is the only recent record of the Dollarbird along Arthurs Creek. In the 1970s they were recorded more frequently (three or four year intervals). See Rainbow Bee-eater (below) for explanation of the decline.

Eb **66^b: Little Friarbird in the flowering Manna Gums at Lintons Bridge.** Four Little Friarbirds were feeding in flowering Manna Gums (5.3) at Lintons Bridge on the Arthurs Creek on 13 March 1989. The Little Friarbird is irruptive to NEM from northern Victoria. It was more common two decades ago and like other predominantly riparian species, including the Dollarbird, Noisy Friarbird and Rainbow Bee-eater, has undergone a decline. Several sightings of Little Friarbirds in NEM were made over summer–autumn 1988/89.

Ec **66^b: Azure Kingfisher.** A single bird observed downstream of Chapel Lane in Manna Gum riparian forest (5.3) along Arthurs Creek on 18 October 1989. The bird was sitting on a low branch of a Manna Gum, from which it pounced on a small fish in the shallows (Southern Pigmy Perch or small Roach). The bird then flew into a burrow in the creek bank, where it presumably had a mate on incubation. Azure Kingfishers are rare in the lowland hills, only being observed along streams supporting substantial populations of fish.

Ee **66^b: Brown Quail and Rainbow Bee-eater.** One quail seen in freshwater meadow under Manna Gum gully woodland (10.1) along the floodplain of lower Stewart Ponds Creek on 8 December 1991. Arthurs Creek at Nutfield forms one of the strongholds of the Rainbow Bee-eater in NEM. Nests are located in exposed banks of the creek under Manna Gum riparian forest (5.3). Birds forage along the creek and in adjoining Yellow Box–Candlebark grassy woodland (14.6) along the valley and Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes. Rainbow Bee-eaters are annual spring-summer migrants from northern Australia and New Guinea, arriving about the second week of October. A population of 60–80 birds was present between Lintons Bridge and 1 km upstream of Chapel Lane at Nutfield through the 1970s and early 1980s. By 1989 it had declined to 20 birds and by 1996 it had declined to six. The following information is from observations at Nutfield recorded between 1979 and 1981.

The bee-eaters had traditional nest-sites which were used each year. Nests were located in enlarged chambers at the end of long narrow tunnels emerging below the top of the creek bank. There were eight nesting colonies comprising two to three breeding pairs and another three to four non-breeding males and juveniles. During November the birds rebuilt their burrows by digging with their bills and scraping out with their feet. Cooperative incubation commenced in early December and the first young were born around Christmas Day.

Successive young appeared to hatch at one to two-day intervals over the following week. The first-born (of usually four or five) emerged in late January. By early February all the population was on the wing. Birds departed around mid-March.

Ef **66^b: Lorikeets in the flowering Manna Gums at Lintons Bridge.** The flowering Manna Gum riparian forest (5.3) in March 1989 attracted all four naturally occurring lorikeets in NEM (Rainbow, Purple-crowned, Little and Musk). These are otherwise locally uncommon.

Eg **66^b: Nesting Wedge-tailed Eagle.** A pair nested in a large eyrie in a Candlebark (Yellow Box–Candlebark valley forest (31.1) on the hill-slopes above lower Stewart Ponds Creek in spring 1991 and 1994. Two young were reared on both occasions (Beverley Brock pers. comm.). Incubation normally commences early to mid-September and the young hatch mid to late October. On 8 December 1991, the fledglings were half grown, with the adults leaving the nest unattended for extended periods while on hunting trips. The hunting range during the breeding season was mainly along the middle and upper reaches of Stewart Ponds Creek. They were often seen soaring in the thermals over the hills around Arthurs Creek Cemetery in mid-afternoon. The pair nested in 1993 and 1995 about 2 km to the east in site 69.

During autumn and winter the eagles spend an equal amount of time hunting over the lower Arthurs Creek and Diamond Creek valleys. Rabbits provide their main food. It is important that the eyries are undisturbed during the breeding season. This is a new nesting pair and the only one known to occur in the lowland hills between the Plenty River and Diamond Creek. The eagle had been locally extinct for several decades. It has made some recovery with increased protection from shooters but this may well be negated given the possibility of broad-acre land subdivision.

66^b: Tree hollow nesting birds at Nutfield. A pair of Gang-gang Cockatoos nested in Yellow Box–Candlebark grassy woodland (14.6) in October 1989 and 1990 on the census plot along the Hurstbridge–Arthurs Creek Road south of Chapel Lane. This is an upland species. Many of the other hollow-nesting birds are plains species. These include the Red-rumped Parrot, Little and Long-billed Corellas, Sacred Kingfisher and White-browed Woodswallow. Five pair of woodswallows bred in in twig nests in Manna Gums and Silver Wattle (5.3) along Arthurs Creek near Burkes Bridge on 30 October 1991, while three pair bred in the Manna Gums (10.1) along Stewart Ponds Creek on 8 December 1991.

66^b: Valley forest/gully woodland bird census: Hurstbridge–Arthurs Creek Road at Nutfield. Ten 2 ha/20-minute counts were conducted in October 1989 and 1990. The transect contained a 500 m section 20 m wide on the east side of the road south of Chapel Lane and a return section of equal length along Arthurs Creek.

Degree of fragmentation: medium (two sides farmland, one side connected along the creek and the fourth side connected to 50 ha of sclerophyll forest extending east to Mine Road). The strip contained a roadside verge and streamway adjoining farmland on both sides. Degree of thinning: medium (tree density of 180/ha). Degree of understorey and ground degradation: medium (moderately intact road and stream verges; adjacent paddocks and timbered slopes).

Vegetation. The first half of the transect consisted of Yellow Box–Candlebark grassy woodland (14.6) and the return section consisted of Manna Gum riparian forest (5.3). Trees/ha (20% cover): 90 Yellow Box, 50 Manna Gum, 25 Long-leaf Box, 10 Narrow-leaf Peppermint and 5 Candlebark. Tall shrubs (10% cover); low shrubs (10% cover); herbs (60% cover).

Results. Bird summary: 65 species and 877 individuals recorded (15 forest, 22 woodland, 13 shrubland and 15 fragmentation species); 43.9 birds/ha composed of 6.6 (15%) forest, 15.6 (36%) woodland, 9.2 (21%) shrubland and 12.5 (28%) fragmentation species

Forest species with densities exceeding 0.5/ha included the Spotted Pardalote (2.4), Striated Thornbill (1.6), Weebill (0.7) and Gang-gang Cockatoo (0.5)

Woodland species with densities exceeding 0.5/ha included the White-plumed Honeyeater (2.9), Striated Pardalote (2.6), Eastern Rosella (2.1), Rainbow Bee-eater (1.0), Tree Martin (1.0), Long-billed Corella (0.9), Dusky Woodswallow (0.8), Australian Ringneck (0.8), Red-rumped Parrot (0.6), Grey Butcherbird (0.6) and Black-faced Cuckoo-shrike (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (2.6), Yellow Thornbill (2.1), White-browed Scrubwren (1.2), Red-browed Firetail (1.0) and Grey Fantail (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Noisy Miner (2.5), Common Starling (2.3), Australian Magpie (1.7), Common Myna (1.6), Galah (1.0), Yellow-rumped Thornbill (0.8), Willie Wagtail (0.8), Little Raven (0.7) and Australian Magpie-lark (0.5)

Parrots: 8 species and 6.0 birds/ha. **Canopy insectivores—migratory:** 12 species and 4.1 birds/ha; **non-migratory:** 8 species and 7.9 birds/ha

Discussion. There were 43.9 birds/ha, 11.9 of which were canopy insectivores (dieback control agents). This is a poor representation, particularly of the forest thornbills and cuckoos. This would be partly attributable to the high population density of Noisy Miners and the linear nature of the habitat strip. The riparian vegetation contained large populations of White-browed Scrubwrens, Red-browed Firetails and Superb Fairy-wrens. The Black Wattles and Hawthorns along the roadside supported Yellow Thornbills.

Eight species of breeding parrots were recorded in the mature Manna Gums, Yellow Box and Candlebarks. This was the highest count in the 16 census plots and included the Long-billed Corella, Gang-gang Cockatoo and the Australian Ringneck (aviary escapee). Several rare riparian species were recorded including the Rainbow Bee-eater, Dollarbird and Azure Kingfisher.

Conclusion. The large Manna Gums along the floodplain and Yellow Box and Candlebarks in the valleys and lower hill-slopes are important for parrots and woodland birds such as the Tree Martin, White-plumed Honeyeater and Striated Pardalote. The narrow and fragmented nature of the habitat links has restricted the forest avifauna and favoured fragmentation species.

Mammals

Ef **66^b: Water Rat.** One in the Arthurs Creek (Manna Gum riparian forest; 5.3) midway between Lintons Bridge and Chapel Lane on 18 October 1989.

Reptiles

Ee **66^b: Red-bellied Black Snake along the Arthurs Creek at Nutfield.** Small populations of Southern Water Skinks and Red-bellied Black Snakes persist along the creek. Delicate Skinks are common amongst the Kangaroo Grass, Common Tussock-grass and Tall Sedge on the floodplain.

Freshwater fish

Ee **66^{abd}: Southern Pigmy Perch and Mountain Galaxias.** Arthurs Creek at Verso's Bridge was electrofished on 14 April 1992. Sixty pigmy perch and five galaxias were taken. The lower Arthurs Creek contains significant populations of pigmy perch. Smaller numbers of both species were recorded at Brock's and upstream of Chapel Lane. The water quality and quantity at both these sites was poor (see Regional Hydrological Strategy).

66^a: Electrofishing Survey: Arthurs Creek—1 km upstream of Chapel Lane

Map reference. 7922 403372. **Altitude.** 100 m. **Survey date.** 14 April 1992

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum riparian forest (5.3; fair condition with alien shrubs and herbs). Frontage: Yellow Box–Candlebark grassy woodland (14.6; poor condition with alien shrubs and herbs)

Physical Features:

Pools

Substrate. Deep silt, logs on sheet sandstone; channel scoured

Maximum size (mid-autumn). 3.5 m wide by 1.0 m deep by 15 m long

Riffles

Substrate. Gravel and cobble on sheet sandstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 3.5 m wide by 20 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 67 ML/day

Water quality

Autumn: Temperature. 18.0°C. **Conductivity.** 310 ms. **Salinity.** 0 ppt. **Turbidity.** High
Winter: Temperature. 10.5°C. **Conductivity.** 80 ms. **pH.** 6.58. **Dissolved Oxygen.**
 10.2 ppm. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Mountain Galaxias (1); likely breeding resident. Southern Pigmy Perch (8); likely breeding resident

Alien species numbers/status. Roach (3); likely breeding resident

Other comments. The Mountain Galaxias is locally threatened. While more common upstream, it is rare in this section of the creek. The flow ceases for extended periods over summer–autumn and the water was stagnant with extensive algal blooms. Land tenure: council reserve and farmland. The reserve requires extensive weed control and revegetation works.

66^b: Electrofishing Survey: Arthurs Creek—Brock property Nutfield

Map reference. 7922 393364. **Altitude.** 85 m. **Survey date.** 15 April 1992

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum riparian forest (5.3; fair condition with alien shrubs and herbs). Frontage: Yellow Box–Candlebark grassy woodland: (14.6; fair condition on east side and cleared on west)

Physical Features:

Pools

Substrate. Deep silt and logs on sheet sandstone; channel scoured

Maximum size (mid-autumn). 6 m wide by 1.5 m deep by 40 m long

Riffles

Substrate. Gravel and cobble on sheet sandstone

Flow (mid-autumn minimum): Size. 0.5 m wide by 1 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.24 ML/day

Flow (mid-winter normal): Size. 4.0 m wide by 30 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 114 ML/day. The shallow section of the creek downstream of the hairpin, Hurstbridge–Arthurs Creek Road corner was flowing strongly and contained 1 m deep pools in winter. In April the section comprised of a string of long, static pools less than 30 cm deep and with scattered pools of 1.5 m deep

Water quality

Autumn: Temperature. 20.0°C. **Conductivity.** 2420 ms (brackish). **Salinity.** 1.2 ppt. **Turbidity.** Cloudy

Winter: Temperature. 10.6°C. **Conductivity.** 90 ms. **pH.** 6.58. **Dissolved Oxygen.** 10.4–11.2 ppm. **Turbidity.** High

Fish Recorded During Survey

Native species numbers/status. Southern Pigmy Perch (3); likely breeding resident

Alien species numbers/status. Nil

Other comments. Platypus were resident and breeding in the 1960s but have not been seen in recent decades (Peter Brock pers. comm.). The electrofishing survey was curtailed to 5 minutes by a thunderstorm. Short-finned Eels are present (Geoff Brock pers. comm.). A small population of the Mountain Galaxias is also present. Land tenure: farmland.

66^d: Electrofishing Survey: Arthurs Creek—Verso's Bridge Midhurst

Map reference. 7922 403340. **Altitude.** 75 m. **Survey date.** 14 April 1992

Vegetation. Instream: submerged and emergent herbfield. Bank (the east bank is grazed and in poor condition; assessments refer to the west bank which forms part of a reserve): Manna Gum riparian forest (5.3; fair condition). Frontage (west bank): Yellow Box–Candlebark grassy woodland: (14.6; poor condition with alien shrubs and herbs)

Physical Features:

Pools

Substrate. Deep silt, logs, branches, leaves and willow roots on sheet siltstone; channel scoured

Maximum size (mid-autumn). 5 m wide by 1.5 m deep by 30 m long

Riffles**Substrate.** Gravel and cobble on sheet siltstone**Flow (mid-autumn minimum):** **Size.** 0.5 m wide by 5 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 1.2 ML/day**Flow (mid-winter normal):** **Size.** 4.0 m wide by 40 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 142 ML/day**Water quality****Autumn: Temperature.** 14.8°C. **Conductivity.** 335 ms. **Salinity.** 0 ppt. **Turbidity.** High**Winter: Temperature.** 11.0°C. **Conductivity.** 110 ms. **pH.** 6.85. **Dissolved Oxygen.** 10.2 ppm. **Turbidity.** Cloudy**Fish Recorded During Survey****Native species numbers/status.** Mountain Galaxias (6); likely breeding resident. Southern Pigmy Perch (60); breeding resident**Alien species numbers/status.** Roach (21); likely breeding resident**Other comments.** The Freshwater Blackfish has been recently recorded. Small populations persist in the deeper pools between Midhurst and Chapel Lane. Land tenure: NRE reserve and cleared farmlets.

Butterflies

Df **66^b: Nutfield.** Twenty-seven species, most of which were recorded in flowering Woolly and Mountain Tea-tree, Burgan and Yellow Box (each in November/December) and flowering Sweet Bursaria (January/February). Important areas are along the Hurstbridge–Arthurs Creek Road and Doctors Gully from Creighton Way to Brocks. Significant species include the Doubleday’s Skipper, Spotted Skipper, Bright Shield Skipper, Phigalia Skipper, Phigalioides Skipper, Symmomus Skipper, Meadow Argus, Dark Purple Azure, Common Imperial Blue, Common Dusky Blue, Double-spotted Line Blue and Chequered Blue. Substantial breeding populations of the Common Imperial Blue are present in the roadside Silver Wattles and Black Wattles.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Loss of habitat links. This is the most acute threatening process operating on the site. Heavy clearing to the west of the creek has led to high attrition rates of native fauna species. Bushland subdivision in the eastern section will bring about similar species reductions.</p> <p>Elimination of shrub and grass cover from farmland gullies. Gullies throughout the district are grazed by livestock. This has led to soil erosion and loss of cover for frogs, reptiles and shrub layer birds. In many situations, Blackberry provides the only habitat for wildlife (e.g. nest-sites for Superb Fairy-wrens and Red-browed Firetails) or protection from severe erosion, but the thickets and tunnel erosion also harbour vermin (foxes and rabbits).</p>	<p>Habitat connectivity. Linear link along the creek to the Wattle Glen to Hurstbridge site. Partial overland links to the Dunmoochin, Pittles Paddock and Haleys Gully Road Red Ironbarks sites.</p> <p>Strengthen habitat links. Maintaining the present native forest, woodland and shrubland avifauna populations will require revegetation of broken links and broadening the grassy woodland strips. Strengthening the eastern links to the Dunmoochin and Pittles Paddock sites will be essential.</p>
Regional Hydrological Strategy	

The effects of clearing and settlement on stream flow. Since settlement the flow of Arthurs Creek has become more directly dependent on rain episodes. Flow that resulted from light rains is now held back by storage reservoirs (Running Creek) and farm dams. The swamps near Arthurs Creek township, which fed the creek through the year from seepage, were cleared and drained. The local catchment forests were cleared. Peat bogs and fern glades in broad sheltered valleys formed permanent springs. Clearing and heavy grazing has enabled the rain water to run rapidly off the compacted paddock surfaces. This floods the creeks, causing erosion in the absence of stable bank vegetation. Originally, a substantial component of water was intercepted by the forest, shrubland and grassland layers and stored in the subsoil by their roots. Water now escapes rapidly through the soil profile and is discharged into the creeks as partially saline groundwater.

Electrofishing surveys—water quality and habitat assessment. The electrofishing site on Brocks contained the highest levels of water conductivity (measure of dissolved solids), salinity, water temperature and turbidity in Arthurs Creek. The bottoms of pools were lined by 5–10 cm of silt. For freshwater fish, settleable and suspended solids should not comprise more than 10% of the stream depth. This level was far exceeded in autumn 1992. These levels slow the growth rate and lower the health rate of fish, reduce the viability of eggs, restrict animal and vegetable food and reduce foraging ability through poor visibility. The principal source of dissolved solids is probably nitrates, phosphates and calcium from livestock faeces in paddock runoff.

High water temperatures cause detrimental changes to water chemistry by activating or depressing chemical processes which can be lethal to aquatic ecosystems. These changes include de-oxygenation which can be by direct oxygen removal (becoming less soluble in warmer water) or indirectly by the promotion of algae which produce toxins or use up oxygen. Decreased levels of oxygen lead to the biodegradation of organic material, further oxygen demand and ultimately the breakdown of ecosystem function (see Wattle Glen to Hurstbridge site). The lack of summer–autumn creek flow and high water turbidity amplifies the problem. Banks over much of the length of Arthurs Creek and its tributaries have been degraded by long-term livestock grazing. Each of the above factors has caused a stressful and potentially eliminating environment for native fish.

Despite the riparian habitat at Brocks being the most intact in the lower Arthurs Creek system, the scenario is a classic example of the effect of streamway degradation caused upstream being off-loaded downstream. The cause and effect relationships arising from catchment land management in the Arthurs Creek system are apparent.

Livestock grazing in paddocks to the waters edge presents a major threat to the riparian vegetation. Severe bank erosion (slumping and gulying and tree and bank undercutting) has occurred on both sides of the creek. The result is advancing weeds, a high water turbidity/siltation rate and a nutrient enriched stream. This is compounded by the severely depleted summer-autumn flow rate caused by catchment dams. The Hurstbridge–Arthurs Creek Road adjoins much of the eastern side of the creek. The native riparian strip is not wide enough for it to act as a substantial faunal corridor.

Electrofishing sites at Brocks and Verso's Bridge. The importance of adequate cover of native riparian vegetation is indicated by the presence of Mountain Galaxias (rare or absent upstream and downstream) and the abundance of Southern Pigmy Perch. Upstream sections are extensively cleared of bank and frontage vegetation while the section downstream of the confluence of Arthurs and Diamond creeks at Haleys Gully Road is dominated by alien plants. The Midhurst to Nutfield section supports native species dominated riparian herbfield and shrubland habitat (e.g. Common Tussock-grass, Hop Goodenia and Sweet Bursaria and Mountain Tea-tree). This has protected the creek banks while providing cover, breeding habitat (shade and debris) and native terrestrial insect prey for native fish. The importance for native fish is also attributable to the abundance of instream herbfield. This benefits the galaxias and the pigmy perch by improving the foraging and oxygen levels and cleansing the water of silt by settling the suspended sediment to the creek substrate.

Rehabilitation and conservation management plan for Arthurs Creek. This should be a high priority for the Arthurs LandCare group. All issues raised in the threatening processes need to be addressed as the instream ecosystem is presently decreasing in viability. The survival of significant species such as the Freshwater Blackfish and Rainbow Bee-eater may depend on fencing a broader section of the streamway from livestock and commencing an intensive revegetation program. This needs to be undertaken in conjunction with systematic removal of woody and herbaceous weeds.

Freshwater Blackfish—threatened in Arthurs Creek. Blackfish are still occasionally taken by anglers. This, along with the other threatening processes, will likely eliminate them from the stream. The same applies to populations in the mid-reaches of the Merri, Diamond and Watsons creeks and the Plenty River. The population in Arthurs Creek is now fragmented and of low density (probably one per large pool, occurring at intervals every few hundred metres of stream). There are possibly only 20 or 30 adult fish (and few young as the predatory Roach and Redfin are present) between Hurstbridge and Arthurs Creek. Roach appeared in the early 1980s and have become common, partially displacing the Redfin (Geoff Brock pers. comm.).

Southern Pigmy Perch and Mountain Galaxias—threatened in Arthurs Creek. The Midhurst section forms the stronghold of the Southern Pigmy Perch in the Arthurs Creek/Diamond Creek system. The instream herbfields provide feeding habitat and the roots of the willows provide breeding habitat for the pigmy perch. The Midhurst section also forms the stronghold of the Mountain Galaxias in the lower reaches of Arthurs Creek. Elsewhere, populations are small and localised. The riparian herbfields and shrublands on the west bank provide their insect prey. The summer–autumn flow (lacking upstream) may be critical for juvenile survival. The water downstream in Diamond Creek (at Haleys Gully Road) appears to be more polluted and the riparian habitat is more degraded. Populations of the galaxias and pigmy perch have declined as a consequence.

Decline of the Rainbow Bee-eater. 1996 is the twenty-second year of counting the population along Arthurs Creek between Lintons Bridge and the old Nutfield post office upstream of Chapel Lane. In 1975 there were eight nesting colonies making up a total of 60 to 80 adult birds. In 1989 there were three colonies and 20 birds. In 1996 this declined to a single colony of five birds. The entire population was seen in one pre-migratory flock near the old post office on 13 March 1989. One of the colonies under intensive study occurs in the south bank upstream of Lintons Bridge. This is the last remaining in 1996. A similar decline has occurred in the Plenty Gorge and elsewhere in NEM. On current trends, the species is unlikely to survive in the region far into the future.

Problem weeds include Blackberry, Hawthorn, White Crack Willow, Blue Periwinkle, Montpellier Broom, Japanese Honeysuckle, Three-cornered Garlic, Bulbil *Watsonia* and numerous grassy weeds including Cocksfoot, Panic Veldt Grass and Water Couch. Some discussion on removal techniques is provided elsewhere in this report (e.g. site 50), but this is beyond the scope of the study. Consultation should be sought with the Shire of Nillumbik and other authorities with regard to procedures and resources. Formulation of a management plan for Arthurs Creek and its tributaries is strongly recommended. Additional summer–autumn water flow is critical. The feasibility of summer release of water from the Running Creek Reservoir needs to be pursued.

The reasons for the decline appear complex. The changing environmental and habitat parameters are adversely affecting the species, which is probably dependent on precise environmental cues. The decline is linked to the long-term effects of land clearing and settlement and increased levels of pesticides, water turbidity, salinity and pollution, exacerbated by lack of water flow over summer (caused by damming). These changes have each reduced the availability of insect prey. The native prey is composed predominantly of aquatic dependent insects such as damselflies, mayflies and caddis-flies. This intolerance to human disturbance and habitat alteration is probably related to the Rainbow Bee-eater's highly specialised and complex ecology and communal lifestyle.

Other Issues

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant woodland and riparian habitat.

Cause

- 1 Land settlement and extensive land clearing and damming in the local and external catchments (e.g. Running Creek Reservoir, farm dams and rural water diversion) and runoff containing high levels of salt and silt.
- 2 Severe vegetation loss and soil erosion such as slumping and gullyng and tree and bank undercutting arising from livestock access to the banks and stream beds of Arthurs Creek and its tributaries.
- 3 Pollution and nutrient enrichment from stock faeces and other contaminating sources including septic tank and domestic outflows and road runoff.

Effect

- a Altered seasonal flows and depleted summer–autumn flow. The breeding activities and movements of migratory species of fish (e.g. Common and Broad-finned Galaxias) are synchronised to natural changes in the flow regime; depleted flows equate to instream habitat loss and changes in water chemistry (causes 1 and 2).
- b High autumn cover of algae and water de-oxygenation and eutrophication; oil-slick (causes 1, 2 and 3).
- c High summer-autumn evaporation rates and water temperatures of pools caused by flow reduction and loss of shading riparian vegetation and resultant exposure to wind and sun (causes 1 and 2).
- d High stream siltation rate and autumn water turbidity/conductivity rate (causes 1 and 2).
- e High autumn water salinity (causes 1 and 2).
- f Altered aquatic ecosystem balance due to the advance of alien weeds and vermin, degradation and malfunction of the instream/riparian ecosystem and decline of native flora and fauna species (causes 1, 2 and 3).

NLH B COTTLES BRIDGE

This management unit consists of two sites of state faunal significance (sites 68 and 69) and one of regional faunal significance (site 67) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 413340 to 7922 437400 (south to north point); 7922 394365 to 7922 451389 (east to west point).

Location/Size: Approximately 800 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit occurs in the foothills of the Eastern Uplands. It lies between the lower reaches of Diamond and Arthurs creeks and forms a line of north-south hills constricted to both sides by the creek valleys. The Templestowe anticline runs diagonally across the south-east corner of the unit (Dunmoochin site). The older, underlying Silurian siltstone/mudstone rock strata (a characteristic of the Nillumbik Hills) has been upfolded and is contained in a ridgeline of north-south orientation, which forms a prominent razorback. On the razorback, the overlying Silurian sandstone bedrock has eroded away, exposing the more durable siltstone. A characteristic of the exposed western face of the siltstone hills are deeply dissected gullies. The sandstone remains in valleys, including Pittles Paddock, which lie to the north of the anticline. There is a clear vegetation transition associated with the two geological types. The closely and steeply folded (siltstone dominated) topography and skeletal nature of the soil separates the Nillumbik Lowland Hills from the widely and gently folded (sandstone dominated) Plenty Upland Hills to the west.

Landforms

Foothill: ridges, hill-crests, hill-slopes, valleys, gullies and dams. A large gold mine of the early twentieth century (Three Chums Mine on Mine Road) has been back-filled. Elevation is 80–230 m.

Hydrology

The unit divides the catchments of Diamond Creek to the east from the catchment of Arthurs Creek to the west. Some of its ephemeral gullies contain large dams. The gullies are fed from direct surface runoff after rain and by gradual seepage from sheltered valley springs. The presence of remnant Rough Tree-ferns suggest that the lower reaches were probably once perennial third order streams. The lower section of Pittles Paddock forms a junction of several valleys and contains an extensive, seasonally wet freshwater meadow.

Rainfall: 640–680 mm. The north-south razorback at Dunmoochin has created a local rainshadow, deflecting rain clouds coming from the south-west to further south (over the hills surrounding Hurstbridge) and those coming from the north-west to further north (along the east-west ridgeline of Mine Road and Hildebrands Road). The rainfall is about 50 mm lower than surrounding areas beyond a 2 km radius and is the lowest in the foothills of NEM.

Site 67 Cottles Bridge–Strathewen Road–Shaws Road

- Map Reference:** 7922 369425 to 7922 425392 (Cottles Bridge–Strathewen Road from Hildebrand Road to Eagles Nest Road); 7922 416385 to 7922 451389 (Greens Road at Hurstbridge–Arthurs Creek Road along Shaws Road to 400 m west of Hildebrand Road); 7922 454388 (Cherry’s bushland). One minute lat/long grids include 37° 34' x 145° 14' and 37° 35' x 145° 12' to 145° 14'.
- Location/Size:** Approximately 310 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Vic Road reservations (e.g. Cottles Bridge–Strathewen Road, Shaws Road, Greens Road). Private: farmland (small livestock and hobby farms in the valleys and bushblocks in the uncleared hills).
- Landforms:** Foothill (see NLH B). Elevation is 110–230 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Messmate gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark grassy woodland (14.6); Yellow Box–Candlebark valley forest (31.1)

Remnant or degraded stands: Swamp Gum gully woodland (10.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2)

Notable features: bushblock stands of forest/woodland with moderately intact ground flora on Cherry’s; linear stand of grassy woodland along the west section of Shaws Road and scattered large trees in the paddocks

FAUNAL SIGNIFICANCE: Site 67 Cottles Bridge–Strathewen Road–Shaws Road

Assessment: Regional–Category 1 (B, C, D, E)

Reference grids for the significance keys include:

67^a: 37° 34' x 145° 14'; Cherry's bushland, Shaws Road St Andrews

67^c: 37° 35' x 145° 13'; Cottles Bridge–Strathewen/Shaws Road, Arthurs Creek

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 67^a: Powerful Owl

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 67^c: 8 species at the Shaws Road grassy woodland census plot

h. Bats

Regional. 67^a: 5 species at Cherry’s bushland on 13 March 1988

k. Frogs

Regional. 67^a: 6 species including the Victorian Smooth Froglet at Cherry’s bushland on 13 March 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 67^a: 112 species

b. Native birds

Regional. 67^a: 90 species

c. Native mammals

Regional. 67^a: 12 species

d. Herpetofauna

Regional. 67^a: 10 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1–R4 species)

Local. 67^a: 9 species

b. Regionally endangered fauna (R1 species)

Regional. 67^c: 1 species. **Birds:** Noisy Friarbird

c. Regionally vulnerable fauna (R2 species)

Regional. 67^a: 4 species. **Birds:** Azure Kingfisher, White-throated Nightjar, Black-eared Cuckoo, Hooded Robin

d. Regionally rare fauna (R3 species)

Regional. 67^a: 1 species. **Reptiles:** Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

Regional. 67^a: 4 species. **Birds:** Peregrine Falcon, Powerful Owl, Rainbow Bee-eater, Speckled Warbler

Regional. 67^c: 2 species. **Birds:** White-winged Triller, Rufous Songlark

f. Regionally restricted fauna (R5 species)

Regional. 67^a: 8 species. **Birds:** Painted Button-quail, Royal Spoonbill, Little Eagle, Australian Hobby, Long-billed Corella, Rose Robin, White-winged Chough. **Frogs:** Striped Marsh Frog

Outlook

The faunal significance may decline from Regional Category 1 to Category 2 due to inadequate habitat links. Fox and feral cat predation is implicated in the decline of several ground fauna species (e.g. Tree Dragon, Brown Antechinus and White-throated Nightjar).

FAUNA

Rare or Threatened Fauna

Bc **67^a: Powerful Owl.** Heard on one occasion at Cherry's bushland (Keith Cherry pers. comm.). This is a distance of 5 km from the nest site of the pair along Smiths Gully Creek and 10 km from other known nesting pairs in the upper Arthurs, Chadds and Diamond creeks. Adult birds and young disperse widely outside the breeding season in late summer/autumn.

Other Significant Fauna

Birds

Eb **67^c: Noisy Friarbird.** One in summer 1986 in Yellow Box–Candlebark grassy woodland (14.6) along Greens Road near Cottles Bridge–Strathewen Road (Danny Rogers pers. comm.). The Noisy Friarbird is now a very rare and irregular summer visitor to flowering Yellow Box, River Red Gum and Manna Gum and to the stream valleys of the lowland hills and alluvial plains. Twenty years ago they were more frequent. A similar trend has occurred for several riparian migratory species including the Rainbow Bee-eater, Dollarbird and Little Friarbird. This is indicative of declining habitat fitness of streamways.

Ed **67^c: White-winged Triller and Rufous Songlark.** These are spring-summer migrants from northern Australia. Both were recorded in Yellow Box–Candlebark grassy woodland (14.6) during the October bird

census transects of 1989 and 1990 along the west section of Shaws Road. The triller bred on the plot both years while a songlark was recorded in passage on 23 October 1990.

67^a: Cherry's bushland bird list. Habitats include Red Stringybark herb-rich foothill forest (6.1), Messmate gully woodland (10.2), Red Box–Red Stringybark box–stringybark woodland (11.1) and Yellow Box–Candlebark valley forest (31.1). A list containing 90 native bird species was provided by Keith Cherry. All but three (Dollarbird, White-winged Triller and Rufous Songlark) of the critical species recorded for the site were from this list. The Azure Kingfisher, Black-eared Cuckoo and Hooded Robin appear to have been passing through. The Black-eared Cuckoo and Hooded Robin have been recorded breeding nearby at Pittles Paddock (site 69). The White-throated Nightjar has not been recorded in recent years and appears to be locally extinct. Other ground species including the Painted Button-quail have become locally rare. Rainbow Bee-eaters have become very rare. In the 1970s they nested in gullies throughout the site, but no nesting records were made during the survey.

67^c: Valley forest/gully woodland bird census: west section of Shaws Road. Ten 2 ha/20-minute counts were conducted in October 1989 and 1990. The transect consisted of a 1 km strip 20 m wide (width of roadway).

Degree of fragmentation: high (three sides complete, one side connected). Degree of thinning: high (tree density of 120/ha). Degree of understorey and ground degradation: medium (moderately intact verges and adjacent paddocks).

Vegetation. The transect contained a narrow roadside verge of Yellow Box–Candlebark grassy woodland (14.6) adjoining farmland on both sides and connected east along Shaws Road to about 20 ha of Red Stringybark herb-rich foothill forest (6.1) and Red Box–Red Stringybark box–stringybark woodland (11.1) at Cherry's bushland. The strip flanked a dry creek (ex-Swamp Gum gully woodland; 10.3) which had been cleared of tree and shrubland vegetation. Across about 500 m of farmland to the west was about 20 ha of thinned grassy woodland along the Cottles Bridge–Strathewen Road. Trees/ha (15% cover): 35 Red Stringybark, 33 Yellow Box, 27 Long-leaf Box, 10 Candlebark, 10 Narrow-leaf Peppermint and 5 Swamp Gum. Tall shrubs (5% cover); low shrubs: (5% cover); herbs: (70% cover).

Results. Bird summary: 45 species and 630 individuals recorded (10 forest, 15 woodland, 7 shrubland and 11 fragmentation species); 31.5 birds/ha composed of 4.4 (14%) forest, 11.5 (37%) woodland, 4.1 (12%) shrubland and 11.5 (37%) fragmentation species

Forest species with densities exceeding 0.5/ha included the Weebill (1.4), Buff-rumped Thornbill (1.1), Striated Thornbill (0.9) and Rufous Whistler (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (2.5), White-plumed Honeyeater (2.5), Dusky Woodswallow (1.6), Eastern Rosella (1.3), Red-rumped Parrot (1.0), White-winged Triller (0.6), Black-faced Cuckoo-shrike (0.6) and Tree Martin (0.5)

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (2.4), Grey Fantail (0.6) and Grey Shrike-thrush (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Common Starling (2.2), Noisy Miner (2.0), Yellow-rumped Thornbill (1.2), Australian Magpie (1.2), Common Myna (1.1), Willie Wagtail (0.9), Eurasian Tree Sparrow (0.8) Welcome Swallow (0.7) and Little Raven (0.6)

Parrots: 5 species and 2.7 birds/ha. **Canopy insectivores—migratory:** 11 species and 4.6 birds/ha; **non-migratory:** 6 species and 8.4 birds/ha

Discussion. The narrow roadside verge contained high densities of woodland and fragmentation species. The presence of mature Candlebarks and Yellow Box influenced the relatively high woodland and hollow-nesting bird count. Forest birds only occurred at the eastern end of the strip, adjoining the herb-rich foothill forest further east. Non-migratory forest canopy insectivores (e.g. Spotted Pardalote; only 0.25 birds/ha) and migratory canopy insectivores, particularly cuckoos, were scarce. The latter can be attributed to the lack of understorey shrubs supporting prospective foster parents for their young.

Conclusion. The 20 m width of the roadside strip is insufficient to support forest birds, but permits movement of some of the more mobile species (e.g. Varied Sittella and Shining Bronze-Cuckoo). The lack of

adequate shrub layers along the roadside influences the low count of shrubland birds and cuckoos (apart from the Pallid Cuckoo which is a farmland species).

Reptiles and frogs

Ec 67^a: Eastern Small-eyed Snake at Cherry's bushland. Ten herpetofauna species were recorded. The Eastern Small-eyed Snake occurs in Red Box–Red Stringybark box–stringybark woodland (11.1). The Tree Dragon has not been seen in recent years. This may be a long-term effect of habitat fragmentation and predation. The Victorian Smooth Froglet inhabits Messmate gully woodland (10.2).

MANAGEMENT

Threatening Processes See other sites in the unit.	Conservation Measures See other sites in the unit.
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective links are present. Fragmented links to Arthurs Creek occur along Greens Road and the Cottles Bridge–Strathewen Road. Fragmented links also occur east of Hildebrand Road to the Diamond Creek Cottles Bridge to St Andrews and Diamond Creek Upper Reaches sites.</p>	<p>Strengthen habitat links.</p> <p>Valley forest/gully woodland bird census plot on Shaws Road. Widening of the strip to at least 20 m into the paddocks on each side of the road for indigenous replanting (particularly shrubs) and natural regeneration would recruit forest and shrubland birds.</p> <p>Implementation of Native Vegetation Clearance Controls on private land.</p>

Site 68 Dunmoochin

- Map Reference:** 7922 416352. One minute lat/long grids include 37° 37' x 145° 12'.
- Location/Size:** Dunmoochin Road between Barreenong Road and Patullos Road Cottles Bridge. Approximately 150 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: road reserves (Barreenong Road, Dunmoochin Road, Patullos Road and Christian Road). Private: bequeathed Dunmoochin Trust Land (Trust for Nature (Victoria)) and bushblocks and semi-cleared farmland. Adjoining land-use: livestock grazing and poultry and bee-keeping.
- The Dunmoochin artist colony and conservation area was established in 1952. Members of the Dunmoochin Artists Society became tenants in common over the unsettled bushland. The society devised a legal constitution and conservation management guidelines. By the mid-1960s with inclusion of neighbouring blocks it comprised 100 ha, of which over 70% remains intact.
- Land was bequeathed from the Clifton Pugh Estate to the Trust for Nature (Victoria). These blocks form the Dunmoochin Trust Land which includes the Tom Uren Sanctuary. They are under conservation covenant and managed as conservation areas as are blocks remaining in the Estate which are owned and managed by the Dunmoochin Foundation. Covenants have also been signed by several landowners. Dunmoochin LandCare group was established in 1992.
- Landforms:** Foothill (see NLH B). Elevation is 80–160 m.

Natural Heritage Values

Landscape. One of the most extensive and intact representatives of the lowland foothills terrain in NEM and the most intact of these on private land. The exposed rainshadow relief of Dunmoochin is a disjunct landform. The known occurrences of the Rosella Spider-orchid are highly localised as foothill box–stringybark woodland has been cleared or grazed throughout Victoria. The presence of the orchid is indicative of long-term protection from livestock grazing.

Scientific and Educational Values

Plant TYPE locality: Rosella Spider-orchid. Percivals Hill.

Rehabilitation and management. The Dunmoochin LandCare group and other private individuals have been involved with extensive habitat rehabilitation and rare plant management. This requires voluntary labour and assistance with funding and grants for ongoing management.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Stringybark box–stringybark woodland (11.3)

Relatively intact and extensive stands: Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Swamp Gum gully woodland (10.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2; sandstone areas to the south at Christians Road)

Endangered species: Crimson Spider-orchid, Rosella Spider-orchid

Vulnerable species: Matted Flax-lily, Wine-lip Spider-orchid

Rare species: Emerald Greenhood, Bearded Greenhood

Critical assemblages or populations: Rosella Spider-orchid Critical Conservation Area (largest known population in the world). Rare or threatened orchids; three reference stands (6.1, 11.1 and 11.3); high orchid diversity (55 species); high native species and regionally significant species (76) diversity

FAUNAL SIGNIFICANCE: Site 68 Dunmoochin

Assessment: State—Category 3 (C, E); Regional (C, D, E)

Reference grids for the significance keys include:

68^a: 37° 37' x 145° 12'; Dunmoochin, Cottles Bridge

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 68^a: Masked Owl, Barking Owl, Brush-tailed Phascogale, Common Dunnart

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 68^a: 6 species trapped on 17 January 1987

i. Arboreal mammals

Regional. 68^a: 4 species including the Sugar Glider and Brush-tailed Phascogale spotlighted below Percivals Hill on 17 January 1987

j. Ground mammals

Regional. 68^a: 5 species including the Common Dunnart, Common Wombat and Black Wallaby on 17 January 1987

k. Frogs

Regional. 68^a: 8 species including the Victorian Smooth Froglet, Striped Marsh Frog and Common Spadefoot Toad heard on a 20-minute frog count from the Dunmoochin ridgeline on 6 February 1990

l. Reptiles

Regional. 68^a: 9 species including the Tree Dragon, Delicate Skink, Lowland Copperhead, Red-bellied Black Snake and Eastern Small-eyed Snake on 28 January 1987

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 68^a: 160 species

b. Native birds

State. 68^a: 122 species

c. Native mammals

Regional. 68^a: 15 species

d. Herpetofauna

Regional. 68^a: 23 species

e. Butterflies

Regional. 68^a: 27 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 68^a: 27 species

b. Regionally endangered fauna (R1 species)

Regional. 68^a: 2 species. **Birds:** Masked Owl, Western Gerygone

c. Regionally vulnerable fauna (R2 species)

State. 68^a: 7 species. **Birds:** Barking Owl, Red-capped Robin, Hooded Robin, White-throated Gerygone, Black-chinned Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 68^a: 7 species. **Birds:** Hardhead, Collared Sparrowhawk, Little Corella, Fork-tailed Swift, Masked Woodswallow, White-browed Woodswallow. **Reptiles:** Eastern Small-eyed Snake

e. Regionally depleted fauna (R4 species)

Regional. 68^a: 11 species. **Birds:** Whistling Kite, Peregrine Falcon, Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Bassian Thrush, Speckled Warbler. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet. **Butterflies:** Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 68^a: 26 species. **Birds:** Painted Button-quail, Brush Bronzewing, Great Egret, Nankeen Night Heron, Australian Shelduck, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brush Cuckoo, Rose Robin, Olive Whistler, White-winged Chough. **Reptiles:** Common Long-necked Tortoise, Delicate Skink, Bougainville's Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Doubleday's Skipper, Spotted Skipper, Phigalia Skipper, Meadow Argus, Dark Purple Azure

g. Nesting birds of prey

Regional. 68^a: Barking Owl (Red Stringybark hollow); Collared Sparrowhawk (stick-nest in a Red Box)

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

Regional. 68^a: Common Dunnart (five recently active nests, two supporting females and young, located in an intensive 10 ha search of the grassy sheltered hill-slopes on 28 November 1987)

e. Honeyeaters

Regional. 68^a: 180 White-naped and Brown-headed Honeyeaters in a 1 ha/20-minute count in flowering Red Box on 11 September 1992

f. Frogs

Regional. 68^a: 30 or more Striped Marsh Frogs, Southern Brown Tree Frogs and Verreaux's Tree Frogs heard on a 20-minute frog count from the Dunmoochin ridgeline on 6 February 1990. The eastern gullies drain to Diamond Creek and the western gullies drain to Arthurs Creek

m. Regionally rare fauna (R3 species)

Regional. 68^a: 20–30 White-browed Woodswallows daily through November/December every 3–5 years; flocks of up to 10 Little Corellas frequently recorded

o. Regionally restricted fauna (R5 species)

Regional. 68^a: over 100 White-winged Choughs at Dunmoochin; the highest population density recorded in GM

Outlook

Faunal species diversity and population density are declining with increasing impact from human disturbance, habitat fragmentation and predation from cats and foxes. Replanting buffers on surrounding land and restoration of habitat links to Diamond and Arthurs creeks may arrest these declines.

FAUNA

Rare or Threatened Fauna

Bc **68^a: Barking Owl.** A pair nests every few years in a trunk hollow of a large Red Stringybark (herb-rich foothill forest; 6.1) in farmland on a sheltered hill-slope to the east of Dunmoochin. They possibly nested in the same tree three times in the 1980s. The breeding territory was confined to about 100 ha, within a larger home range of around 300 ha. This contains alternate nest-sites which are used in other years as prey abundance fluctuates.

At Dunmoochin, the barking call was mainly heard prior to dusk during the mating season (May–June). Eggs (usually 2–3) were laid in July and the female incubated for a little over a month. Two young were reared in 1989. These fledged in late October and remained with the adults for several months (observed in early December). During the breeding season, the male roosted alone during the day in a dense Red Box near the nest-tree. When the unfledged young emerged in early October, they roosted together with the female in the nest-tree. Once they could fly, they roosted in the Red Box used by the male.

Analysis of pellets located around the roost trees determined the main prey of the Dunmoochin birds to be Sugar Gliders and young rabbits. There were also skeletal remains of a Common Ringtail Possum and a few birds. Prey are taken from all vegetation strata and from the air and the ground. The Barking Owl often leaves the roost some time before dark. It has an unusual hunting strategy of sitting at a vantage to swoop on arboreal prey (e.g. Sugar Gliders and bats) as they emerge from tree hollows. Other sources list rats and large insects such as moths as supplementary food.

The Dunmoochin nesting pair thins out the local population of Sugar Gliders. It takes three to four years for glider populations to build up enough for the owls to return. In 1989, a population of eight or nine Sugar Gliders had taken over a nest box in Red Box–Red Stringybark box–stringybark woodland (11.1). Every few nights over several weeks in August, the male, issuing a screaming call, ‘picked off’ a glider as it emerged from the nest box. The male would alight on a nearby branch, crush the glider in its talons, disembowel the tail and then depart for the nest, uttering several more screams on the way. This was possibly to alert the female, sitting on eggs in the nest hollow. The female would leave the hollow for a nearby branch where the male would transfer the food-item, accompanied by some pair-bonding and vocal by-play.

Bc **68^a: Masked Owl.** A young bird roosted in a Monterey Pine on 4 March 1991. It was being mobbed by magpies and choughs. The rasping night call had been heard on several occasions over preceding weeks. Masked Owls were recorded again in winter 1993 and 1994 (adults) and autumn/winter 1996 (calls on several occasions) with a sighting of a light phase bird (possibly juvenile) at the top of the steep hill on Barreenong Road (Pat Vaughan pers. comm.). These birds are possibly the adults and offspring that breed about 3 km to the north-east near the Diamond Creek (site 75).

Bc **68^a: Common Dunnart.** There are possibly 15 to 20 adult Common Dunnarts inhabiting the 30 ha of suitable habitat (intact, grassy sheltered hill-slopes under Red Stringybark herb-rich foothill forest; 6.1). This was derived from an intensive area search of 10 ha of this habitat conducted on 28 November 1987 which located five recently active nests, two supporting females and young. The dunnart builds a cup-shaped nest of dry grass, leaves and stringybark fibres and places it in a hollow log, under a flat log or sheet of iron or in a dense tussock of grass. Normally only one adult occupies the nest. The population figure is purely an estimate based on one survey and a quantifier of the area of suitable habitat available. Whether the animals occupy all of it is unknown.

Population density could only be assessed accurately after standardised, intensive and repeated pitfall surveys. Dunnarts are notoriously difficult to catch in conventional mammal traps. From studies elsewhere, the distribution of the Common Dunnart was found to be locally patchy (i.e. not utilising all potential habitat) but, where present, was recorded at densities of up to six animals per hectare (Strahan 1988). The species inhabits heathland as well as herb-rich foothill forests and woodlands. This figure was recorded in two to four-year-old fire regrowth (possibly heathland). The species was found to be adapted to a mid-successional complex of vegetation and therefore benefits from periodic burning of its habitat. This is interesting to contrast to

Dunmoochin. The area surveyed is dense regrowth herb-rich foothill forest of 300–400 trees/ha that has remained unburnt since 1939. It is to be expected that the population densities are low.

The Common Dunnart at Dunmoochin is threatened by a number of factors: further severance of adequate external habitat links; increased internal habitat degradation; modification and loss (e.g. removal of logs and weed invasion); the presence of relatively high populations of predators (including cats and foxes); and the sparse availability of prey (beetles, cockroaches, cricket larvae and spiders). Optimal population levels of Common Dunnarts would require specific habitat requirements related to prey and cover abundance.

Bc **68^a: Brush-tailed Phascogale.** The population at Dunmoochin is small. Seven live sightings and one road-kill have been made over the last 10 years. Six of the live sightings were made in Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes of Percivals Hill at the southern end of Dunmoochin (five by spotlight and one in a tree-trap). All recent sightings in the breeding season have been confined to this valley. The seventh sighting was of a juvenile male in a nest box in Red Box–Red Stringybark box-stringybark woodland (11.1) at the north end of Dunmoochin.

Breeding adult females occupy exclusive home ranges of 4 to 5 ha containing traditional nest-trees (shared by successive mother/daughters). Outside the breeding season the range of females appear to be unfixated and related to food resources. They usually live for two years and males normally less than one year. Young are born in a litter of up to six in late winter and early spring and remain in maternal care for five to seven months. Males are more mobile and occupy much larger home ranges of 50 ha or more containing several alternative roosts, overlapping with several females (Strahan 1988). In early late summer–autumn, males disperse widely and are dependent on forest links. When crossing open country they are prone to predation from cats and foxes. Several have been picked up in the district as road-kills at this time.

The sheltered hill-slopes of Percivals Hill contain the highest density of mature trees at Dunmoochin. This is also the area of lowest density housing and domestic cats. The phascogale spends much time on the ground (where its main prey are House Mice, beetles and large, ground-emerging noctuid and swift moths). The open understorey at Dunmoochin places them at risk to predation as they can be seen and caught by an agile cat. When disturbed they scale tree-trunks but often hide on the upper surface of branches rather than fleeing to the relative safety of the canopy extremities. Females with attached young in early spring are particularly vulnerable.

The survival of the Brush-tailed Phascogale at Dunmoochin is dependent on much the same factors as is the Common Dunnart (see above). The re-establishment of habitat links to populations along Diamond Creek may be critical (see Cottles Bridge–St Andrews site). The phascogale naturally occurs at low population densities (perhaps around five animals over 100 ha at Dunmoochin). Males are inclined to travel long distances and occupy large territories. Severance of cross-country links from Dunmoochin may have produced a dispersal barrier. Three road-killed males have been obtained in the district over the last 10 years. The lack of mature trees and tree hollows due to logging at Dunmoochin may have been a major limiting factor. The average age of stands now exceeds 50 years and particularly the Long-leaf Box, are beginning to support tree-hollows of sufficient size for phascogales. Nest boxes are used intermittently, mainly by dispersing males.

Critical Assemblages and Populations

Db 68^a: Bird observations at Dunmoochin, 1986–1996. One hundred and twenty-two native species were observed. The vegetation consists of Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes, Red Box–Red Stringybark box–stringybark woodland (11.1) on the hill-crests and exposed hill-slopes, Red Stringybark box–stringybark woodland (11.2) on the exposed valleys and Yellow Box–Candlebark valley forest (31.1) in the sheltered valleys. Gullies adjoining Dunmoochin support Swamp Gum gully woodland (10.3). These have been cleared to the east whilst a partially intact gully drains the south-western section.

Significant species:

- Painted Button-quail: seen annually in summer in the 1980s (e.g. 28 January 1987) and similar to other ground birds such as the Bassian Thrush becoming infrequent; 11.1
- Brush Bronzewing: one observation (19 April 1990); rare autumn-winter visitor from breeding areas along upland streams and gullies; 6.1
- Great Egret: occasional visitor to large paddock dams (e.g. June 1988 on Christians dam)
- Nankeen Night Heron: juvenile roosting in a house garden in autumn 1992
- Australian Shelduck: occasional visitor to large paddock dams (e.g. 27 June 1988)
- Hardhead: one sighting of 6 birds on Christians dam in June 1988
- Collared Sparrowhawk: breeding resident; stick-nest in a Red Box in spring 1994; 6.1
- Little Eagle: seen about once a year overhead, mainly in autumn-winter (e.g. June 1987, May 1989)
- Whistling Kite: seen once overhead in April 1990
- Peregrine Falcon: seen 1-2 times a year overhead, mainly in autumn-winter (e.g. June 1987, May 1989)
- Australian Hobby: frequently seen hunting through the canopy of 6.1 and 11.1 in spring–summer 1995/96 and apparently breeding locally; occasional birds passing overhead previously
- Barn Owl: winter 1987 and 1989 during local irruptions into the Melbourne area; frequently heard calling at night; not recorded since
- Rainbow Lorikeet: first recorded in March 1991, moving across catchment between flowering Manna Gums along Arthurs and Diamond creeks; seen in autumn–winter most years due to a population expansion from a centre between Eltham and Diamond Creek
- Purple-crowned Lorikeet: seen in passage in January 1988 and frequently over May–June 1991; the latter when a heavy nectar flow was occurring in the Panton Hill–Smiths Gully Red Ironbarks
- Little Lorikeet: infrequently recorded flying overhead; breeds in Manna Gums along Diamond Creek
- Little Corella: populations have steadily increased since first recorded in 1987; 5–10 birds visited Golden Wattles in the Tom Uren Bird Sanctuary, daily feeding on seeds in November/December 1996; frequently flying overhead; breeds along Arthurs Creek
- Long-billed Corella: small flocks moving between Arthurs and Diamond Creek seen perhaps on a weekly basis flying over; with increasing frequency since 1991
- Australian King-Parrot: autumn passage visitor from the ranges seen on 2–3 occasions (e.g. 4 April 1992)
- Rainbow Bee-eater: flocks of 10–15 feeding over the Dunmoochin Road ridgeline annually between 1986 and 1989 on arrival in mid-spring and before departing in March (bred along Arthurs Creek in site 66 and Pittles Paddock and a gully below the Old Cottles Bridge–Strathewen Road in site 69; now four or five birds seen less frequently)
- Brush Cuckoo: heard in gullies (10.3/31.1) on 2–3 occasions in mid-spring (e.g. 1 November 1988) on arrival from northern Australia; not breeding at Dunmoochin
- Fork-tailed Swift: On 8 March 1990, a huge flock of this species was observed over GM. Swifts were everywhere the eye could see for an entire afternoon—numbers must have been in the tens of thousands. They all appeared to be flying northwards (perhaps on migration). In addition the characteristic Fork-tailed Swift screaming sounds were heard until well after dark. Such a large flock of this regionally rare species is unparalleled over the last 20 years.
- Red-capped Robin: pair seen in Yellow Box–Red Stringybark box–stringybark woodland (11.2) south of Dunmoochin (near Christians Road) in April 1989; nested in this locality in a Hedge Wattle in the early 1980s

- Hooded Robin: two birds at Dunmoochin Road in June 1989; 11.1
- Rose Robin: seen in October migration every few years before moving on to breed along local creeks
- Leaden Flycatcher: several pairs breed annually in the head of gullies west of Dunmoochin Road; 6.1/31.1
- Bassian Thrush: 10 or more birds visited the sheltered hill-slopes every autumn–winter until the mid-1980s; now one or two seen every few years; suffering from cat and fox predation and being pushed out by Common Blackbirds from gullies; 6.1/11.1/11.3
- White-winged Triller: pair nested in partially cleared farmland in November 1988; 31.1
- Speckled Warbler: resident in small numbers on the hill-slopes; 6.1/11.1
- Olive Whistler: upland visitor seen on 23 April 1994 in a thicket below a dam; 14.6
- White-throated Gerygone: heard in the valleys (31.1) every few years for a day or two in late October on arrival from northern Australia before moving on
- Black-chinned Honeyeater: occasional winter visitor (usually 1–2 birds) with the White-naped Honeyeater (e.g. May–June 1991) in years when a heavy nectar flow was occurring in the Panton Hill–Smiths Gully Red Ironbarks; 11.1
- White-winged Chough: highest population density in GM!

Other Significant Fauna

Birds

Eb **68^a: Western Gerygone.** An adult called briefly in Red Box–Red Stringybark box–stringybark woodland (11.1) along Dunmoochin Road on 22 October 1995. They have not been seen before or since at Dunmoochin. A pair was located in early November 1995 breeding nearby at Pittles Paddock (site 69). This bird was possibly one of those. This inland species is very rare in NEM, with only two other sightings in the last decade. It is an annual spring–summer migrant from northern Australia to box–stringybark woodlands in northern Victoria, but rarely enters southern Victoria.

Ed **68^a: White-browed Woodswallow.** Every three to five years in November/December 20–30 feed daily during mid to late afternoon over the Dunmoochin ridgeline. These birds breed in Manna Gums along nearby sections of Diamond and Arthurs creeks. The warm updraught sweeps mating swarms of insects into the air. These attract aerial feeders such as woodswallows and needle-tails.

Fo **68^a: White-winged Chough.** See ‘ecological imbalance of bushland refugia due to fragmentation and human settlement’ under Threatening Processes.

68^a: Observations on autumn–winter foliage insectivores

Critical predator/prey balance between birds and insects in forest ecosystems. Insufficient numbers of insectivores due to forest fragmentation and urban development in forest stands in NEM has led to widespread declining tree health (e.g. dieback induced by large populations of foliage insects). An area the size of Dunmoochin (100 ha) appears to have a natural predator/prey balance, as the observable level of damage from leaf invertebrates is low. Stands of diminishing size (particularly when less than 25 ha) become increasingly prone to foliage damage.

Foliage insectivores. While breeding in spring and summer most of the smaller, resident insectivore species at Dunmoochin, including the thornbills (Weebill, Speckled Warbler and Buff-rumped, Striated and Yellow Thornbill), pardalotes (Spotted and Striated) and the honeyeaters (White-naped and Brown-headed), form communal colonies and become territorial. Most of the spring migrant insectivores are either solitary cuckoos or nesting pairs (e.g. Rufous Whistler, Olive-backed Oriole and Leaden Flycatcher). From late March to mid-April, mountain birds such as the Flame Robin, White-eared Honeyeater, Golden Whistler and additional Spotted Pardalotes and White-naped Honeyeaters arrive and the spring migrants depart.

Autumn-winter foliage insectivore feeding flocks. The foliage insectivores become mobile mixed species flocks which range over a wider territory once breeding is over and young are independent of parental care. To cope with dwindling seasonal food supplies, territorial boundaries within species become more fluid and neighbourhood pairs/communes forage and watch for predators together. Within these groups, species adopt socially interactive feeding strategies. The Striated and Buff-rumped Thornbills live in sedentary communal

colonies of four to five birds over small territories (2 ha) while breeding. In autumn they join a neighbourhood clan containing up to 20 of each species (i.e. four or five colonies of each).

Autumn-winter neighbourhood clans and feeding guilds. At Dunmoochin there are possibly 10 insectivore clans occupying 8 to 10 ha apiece. Foliage insectivore feeding guilds are composed of two or three clans. Each guild includes a hill-crest/ridge and exposed hill-slopes (Red Box–Red Stringybark box–stringybark woodland; 11.1), sheltered hill-slopes (Red Stringybark herb-rich foothill forest; 6.1) and one or two valleys (Red Stringybark box–stringybark woodland; 11.3) and gullies (Yellow Box–Candlebark grassy woodland; 31.1). Open paddocks surround the 100 ha of bushland. The bushland follows a razorback which connects five hills and side valleys. Each of these contains a foliage bird guild (occupying 20 to 25 ha). Each of the larger insectivores is resident within a clan area as are the smaller thornbills, pardalotes and Brown-headed Honeyeater.

There are influxes of nomadic populations of Spotted Pardalotes, White-naped Honeyeaters and Silvereyes from the uplands and the coast into the area, often forming large, mobile flocks. These cycle through on a bigger circuit. Members of the insectivore clan join in with them as they move through, the Spotted Pardalote remaining numerically dominant (up to 50 birds). The feeding activity of the honeyeaters and, to a lesser extent, the Striated Thornbill, switches from insects to nectar in August/September when the Red Box flowers. In years such as 1992 (about one in ten years) when the Red Box flowers heavily, several hundred White-naped Honeyeaters and up to 100 Brown-headed Honeyeaters, are present. Heavy flowering of Yellow Box usually follows in October/November. On these occasions the honeyeaters breed locally (e.g. valleys at Dunmoochin and the neighbouring Pittles Paddock).

Autumn-winter feeding behaviour of the smaller insectivores. The species of small insectivores each occupy separate feeding niches. Of the numerically abundant species, the Striated and Buff-rumped Thornbills largely feed amongst the branches and twigs of trees and the Spotted Pardalote and White-naped Honeyeater, from the foliage. The Weebill is adept at hovering over the extremities of the mid-strata and canopy branches of trees and tall shrubs, associating with the Striated Thornbill in the canopy and the Buff-rumped Thornbill in the mid-strata. The Buff-rumped Thornbill also forages in the low strata and is equally at home on the ground, tussocks and shrubs, where it associates in more open and grassy sections with the Speckled Warbler, Yellow Thornbill and Yellow-rumped Thornbill.

The Striated Thornbill keeps within the eucalypt and tall shrub canopy and the Yellow Thornbill to the canopies of the tall shrubs and saplings (also in association with the Speckled Warbler), entering tree canopies only when on the edge of cleared land. The Striated Pardalote and Brown-headed Honeyeater tend to forage in the inside and middle of the tree canopy where nocturnal insects shelter, while the Spotted Pardalote and White-naped Honeyeater predominantly move through the sunny surfaces of the tree strata in search of leaf psyllids.

Autumn–winter feeding behaviour of the larger insectivores. The area occupied by the neighbourhood clans of thornbills and pardalotes overlaps the smaller territories of several individuals or pairs of larger and more sedentary insectivores. The most common of these include the White-eared Honeyeater, Grey Fantail, Scarlet Robin, Golden Whistler, Grey Shrike-thrush and White-throated Treecreeper. The White-eared Honeyeater is solitary and has a small territory of 1–2 ha. They have a varied and generalised diet and feeding behaviour. They join the neighbourhood insectivore clan in apparent vocal and activity contact, often pouncing on dislodged insects too large for the smaller birds.

The White-throated Treecreeper forages along the trunks and branches in a specialised manner. The Grey Fantail, being an active and agile aerialist, occupies the small openings between shrubs and low trees, foraging around all strata. The Scarlet Robin is also an aerial forager, but sallies for flying insects from a vantage amongst natural clearings and along roadsides. The Flame Robin, which hunts like the Scarlet Robin, inhabits the edge of open paddocks and bushland with the Yellow-rumped and Yellow Thornbills. While tearing off bark to uncover invertebrates, the White-eared Honeyeater interacts with the White-throated Treecreeper and Grey Shrike-thrush. The White-eared Honeyeater and Golden Whistler spend more time than the shrike-thrush in the tree canopy. The shrike-thrush, whistler, fantail and honeyeater spend about equal time in the shrub layers while the shrike-thrush is far the most ground-active.

Insectivore guild feeding waves. At Dunmoochin the insectivore guild has a feeding phenomenon best described as a ‘wave’. This influences about a 5 ha neighbourhood at any one time, usually occurring on cycles

of early to mid morning and mid to late afternoon. The waves take about 10 minutes to pass through, building from the valleys, sweeping up the hill-slopes and culminating on the hill-crests. The combined feeding activity keeps the insects stirring. The waves coincide with insect feeding or reproduction activity peaks and hill-topping movements. At the right cue about once a day (possibly environmental conditions influencing the activity of insects) over 200 foliage birds of up to 20 species combine in a large wave. This complex social behaviour pattern involves all of the foliage insectivores within the neighbourhood, many from outside (within the guild) and the nomads.

A typical run down of the guild includes about 50 Spotted Pardalotes (say 40 upland visitors and the two neighbourhood colonies), 4 to 6 Striated Pardalotes, 30 Buff-rumped Thornbills, 30 Striated Thornbills, 5 to 10 Weebills, 5 to 10 Yellow Thornbills, 2 Speckled Warblers, 2 Scarlet Robins, 2 Grey Shrike-thrushes, two Golden Whistlers, 2 Grey Fantails, 1 to two White-eared Honeyeaters, two to four White-throated Treecreepers, 0 to 10 Varied Sittellas, 0 to 10 Silvereyes, 10 to 30 White-naped Honeyeaters, 2 to 10 Brown-headed Honeyeaters (an occasional flock of 10 or so nomadic birds passing through with the White-naped Honeyeaters), 0 to 2 Flame Robins and 0 to 6 Yellow-rumped Thornbills. The wave suddenly dissipates and the resident birds disperse over the neighbourhood and the nomadic birds move on.

Butterflies

Df **68^a: Dunmoochin.** Twenty-seven locally breeding species were recorded between 1993 and 1996 and five non-breeding vagrants have been recorded since 1982. An unconfirmed sighting of a hill-topping Large Ant-blue was made on 21 January 1996 (not included). This species is listed vulnerable in Victoria. A colony of the rare attendant ant is being closely monitored and it is hoped that the ant-blue can be verified in the future. Unless otherwise stated, butterfly records are of breeding larvae or hill-topping/nectar-feeding adults in Red Box–Red Stringybark box–stringybark woodland (11.1) along Dunmoochin Road.

Significant species

- Doubleday's Skipper: several from 7 to 25 November 1993 and 20 November 1995 to 9 January 1996; this species was absent prior to 1993 and has extended its range north from the Yarra over recent years; not confirmed breeding but likely on Weeping Grass
- Donnysa Skipper: seen on only one occasion (8 December 1993) in the western valley (habitat 11.3) where presumably breeding on Thatch Saw-sedge
- Spotted Skipper: brief adult emergence from 21 to 28 November 1993 and 16 to 23 November 1996; uncommon locally but confirmed breeding on Thatch Saw-sedge (habitat 6.1)
- Phigalia Skipper: small numbers from late October to early December each year; confirmed breeding on Wattle Mat-rush
- Phigalioides Skipper: small numbers from late November to early January each year; confirmed breeding on Wattle Mat-rush
- Symmomus Skipper: several newly emerged females on 2 March 1996; confirmed breeding on Spiny-headed Mat-rush (habitat 31.1)
- Bright Shield Skipper: relatively common from early January to mid-March; territorial in mid-stratum foliage; confirmed breeding on Grey Tussock-grass
- Wood White: two adult generations (October/November and January/February); females ovipositing on Cherry Ballart on 18 October 1996; larvae present in November/December
- Meadow Argus: locally rare (10 December 1993 and 12 October 1995); uncommon in the foothills and more frequent on the volcanic plains; breeds locally on introduced Centaury
- Dark Purple Azure: female on 21 January 1996 in search of larval food-plant Creeping Mistletoe (none present) before moving on; breeds nearby in site 69
- Olane Azure: usually one or two hill-topping Dunmoochin Road from late November to late January each year; breeds nearby in site 69 on Drooping Mistletoe
- Blue Jewel: hill-topping male on 21 January 1996; female seen several times over the following week in a grove of Black Wattles (ovipositing on trunks)
- Double-spotted Line Blue: commences flying in early December peaking in flowering Sweet Bursaria in January; frequent in 1993 and 1996 and absent or rare in 1994/95; confirmed breeding on Woolly Wattle

- Common Imperial Blue: colony of 50 to 100 breeding in three to four-year-old Black Wattles in the Tom Uren Sanctuary from November to February 1993/94 and 1994/95 and then vanished as wattles matured
- Several non-breeding vagrant species have also been recorded since 1982, during local irruptions from the inland. These include:
- Caper White: minor irruption during October 1995 and minor irruption in October/November 1996
 - Small Grass Yellow: several on 10 October 1995 and 27 September 1996
 - Chequered Swallowtail: major irruption between 20 and 22 November 1993
 - Wanderer: November/December 1982 during the last drought
 - Lesser Wanderer: November/December 1982 during the last drought

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. There is an intact link to the Pittles Paddock site. Partially fragmented links north-west through Pittles Paddock and west to the Hurstbridge to Arthurs Creek site and south-east and east across semi-cleared land and a timbered gully adjacent to the Cottles Bridge–Strathewen Road to riparian forest along Diamond Creek in the Cottles Bridge–St Andrews site.</p>	
<p>Habitat link severance. See Brush-tailed Phascogale in fauna.</p> <p>Lowland hill reference stand vegetation. The land and biotic systems of Dunmoochin have been severely affected by land clearing and farming throughout Victoria. Dunmoochin is one of few sites in Greater Melbourne that support two endangered species. This presence is indicative of the land being over several generations and prior to this, subjected to relatively low levels of farming impact.</p>	<p>Conservation covenants and the Dunmoochin LandCare Group. Dunmoochin is just 3 km by line from the urban centre of Hurstbridge. It has a unique history of over 50 years of conservation management. Surrounded by cleared farmland, it now forms an isolated stand of bushland. In order to protect the highly significant habitats and threatened indigenous plant and animal species, several of the blocks have been placed under conservation covenant. Others are listed under Land For Wildlife or bequeathed to the Trust for Nature (Victoria) and maintained by a committee of management. Dunmoochin has a detailed scientific database and a LandCare Group formed by the residents. This group participates in land protection, weed control and tree planting. Groups such as the Australian Trust for Conservation Volunteers are periodically engaged in land protection works.</p>

Soil erosion. This is discussed more fully under Threatening Processes in Volume 1. Most remaining stands of lowland box-stringybark woodland in NEM have regenerated from past clearing episodes. Remaining stands protected from grazing, such as Dunmoochin, have been logged several times. Topsoil on the exposed hill-slopes has been removed by sheet erosion. The dense regrowth consists of multi-trunked trees and the shade competition, in tandem with lack of topsoil and soil moisture, provides a hostile environment for perennial native grasses and shrubs. It benefits annual weeds of open ground or disturbance (e.g. Squirrel-tail Fescue, Elegant Plume-grass, Large Quaking-grass, Annual Veldt Grass and Mouse-eared Chickweed).

Ecological imbalance of bushland refugia due to fragmentation and human settlement. In common with other areas of bushland in the lowland hills, the impact of humans both past and present has altered the natural balance of ecosystems at Dunmoochin. The direct and indirect effect of human settlement has led to an increase in the populations of several native species including the White-winged Chough, Eastern Grey Kangaroo, Common Brushtail Possum and Common Ringtail Possum. Other species of the open country such as the Little Raven and Australian Magpie have colonised the periphery of the bushland, particularly near houseblocks. Each has played a role (some to a greater extent than others) in damaging native vegetation or competing with bushland fauna..

Increased grassy fuel load. On the negative side, many of the grasses are aliens, which presents a management problem. The alien grassy fuel load is increasing the risk of bushfire. The aspect and steep slopes at Dunmoochin, in combination with inadequate fire prevention measures, has placed most of the houses in a high fire risk category in extreme 'fire weather' conditions (Bernie Murray pers. comm.)

Increased grassy fuel load. The processes which have favoured the White-winged Chough may be slowly reversing. This is being achieved by direct effects and indirect effects. Direct effects include reduction in the amount of free-feeding from residents. Indirect effects include the revegetation of cleared blocks which reduces fragmentation boundaries. (For more details of this revegetation see the margin note.)

Another indirect effect is the increased cover of grasses, shrubs, litter and ground logs in the bushland understorey as part of a natural plant succession. As the tree stratum matures, it opens from forest to woodland (i.e. the weak coppice of old rootstock trees from logging episodes thin out). On the positive side is the reversal of erosion and provision of habitat for niche specialists including the Painted Button-quail, Bassian Thrush, Speckled Warbler and reptiles and reduction of habitat for open ground generalists such as the White-winged Chough.

Trial late spring burning also favoured disturbance weeds and attracted foraging activity of White-winged Choughs. Fuel reduction by fire is a useful management tool, but needs to be conducted in a mosaic so areas are not burnt too frequently.

Loss of substrate—ground logs and branches. This is due to the effects of past logging and contemporary timber extraction. The latter includes firewood gathering (excessive fuel reduction burning has a similar effect). This has reduced the habitat and increased the risk of predation for ground fauna such as the Tree Dragon. Several predatory birds have increased as a result of habitat fragmentation. These include the Little Raven, Grey Currawong, Laughing Kookaburra and Australian Magpie. Most are supplemented by human food-scrap and hand feeding. These birds prey on reptiles (particularly dragons and skinks).

Trial late spring burning on the exposed slopes assisted in fuel reduction (bushfire protection), Large Quaking-grass control and the growth and reproduction of orchids, native tussock grasses and shrubs.

Replacement of ground logs as ground fauna habitat. Removal of ground timber for firewood has depleted the ground fauna habitat, particularly for reptiles, and contributed to tunnel and sheet erosion. Dunmoochin has an over-abundance of competitively weak, mid-strata sapling trees. These have crowded or starved out the understorey shrubs and native grass and favoured the advance of alien grasses such as the Large Quaking-grass. One method to counter this effect has been to push over the weaker vertical coppice growth (the regrowth usually has two or three weak trunks and one or two strong ones) and lay them across the hill contours.

Sheet erosion on exposed hill-slopes and tunnel erosion in gullies in management areas has been turned around in two to three years and soil and litter has developed on ground that had been bared to rock. Orchids are recolonising. Several of the hill-slopes, which until a few years ago contained only the Garden Skink and Eastern Brown Snake, now contain nine species of reptiles. The arrivals include the Delicate Skink, Bougainville's Skink, Weasel Skink, Tree Dragon, Lowland Copperhead, Common Blue-tongued Lizard and Blotched Blue-tongued Lizard. Several of these had not been previously recorded at Dunmoochin.

Other issues

The predation of native wildlife by foxes and cats. There are substantial populations of foxes in the Dunmoochin area and domestic and feral cats roam the bushland during the night. Foxes and cats prey heavily on ground birds (e.g. Bassian Thrush and Painted Button-quail) and waterbirds (e.g. Pacific Black Duck) from adjoining dams. Cats are a threat to small arboreal mammals (e.g. Brush-tailed Phascogale and Common Dunnart). The Bassian Thrush visits the central section of Dunmoochin for the winter but no longer the northern section where a higher density of houses occurs. On two occasions over the last decade the feathered remains of Bassian Thrush have been located. See Volume 1 for a discussion of cat predation on wildlife.

Environmental weeds and disturbance areas such as road frontages and dwellings. Most hill-crests amongst less settled bushland of the Nillumbik and Plenty Lowland Hills contain houses and roads/tracks. Most valleys have roads or dams and many have houses. The weeds most threatening native ground flora at Dunmoochin are the Large Quaking-grass on exposed hill-slopes and Sweet Vernal-grass and Panic Veldt Grass on sheltered hill-slopes. These have been spread by ground disturbance such as roading, homesites and adjoining land clearing. A large proportion of the seed accumulation and seedling establishment of Large Quaking-grass occurs on roadsides while that of Panic Veldt Grass occurs around houses.

Review of the impact of companion animals. The predatory activities of household cats is a particular concern. For further discussion see Volume 1

Foxes. Foxes are also contributing to the spread of weeds such as Blackberry and Boneseed. They need to be controlled.

Common Dunnart management. Long-term survival of the species in habitat refugias such as Dunmoochin will require management including: identifying distribution and habitat requirements; replanting or promoting native tussock grass and low shrub cover or promoting natural regeneration by some thinning out of the regrowth; replacing logs and other substrate habitat; minimising disturbance (including household and earthworks such as roadways) which lead to habitat loss and degradation; re-establishing external habitat links; removing weeds; controlling predators; and mosaic control burning. These are the essence of the management requirements of many of the threatened orchids at Dunmoochin.

Brush-tailed Phascogale management. The long-term survival of the species will require management similar to that outlined for the Common Dunnart. Re-establishing effective habitat links and controlling predators to increase the low population density may be critical.

Road frontage management. In conjunction with a weed eradication program (particularly Large Quaking-grass) and reduction of disturbance factors which favour alien species, the roadside verges need to be replanted with native grass and shrub species.

Other species colonising from the roadways include Common Onion-grass, Cocksfoot, Brown-top Bent and clovers, the latter spread by road grading. The presence of bare table drain batters and frontages provides colonisation areas. This prepares the way for invasions of perennial grasses such as Panic Veldt Grass and Sweet Vernal-grass. Seeds move down the catchment by water movement, assisted by diversion gutters over the hill-slopes and into the gullies.

Mosquito Fish and declining frog populations. Many of the dams have been stocked with Mosquito Fish and the number of frogs has declined substantially in recent years. This is a widespread problem in NEM.

Rare orchid protection work. Most of the significant orchids are in population decline. Work has been aimed at improving the long-term viability of these species. This has included survey and identification, placement of wire enclosures as protection from White-winged Choughs, control of alien grasses, ecological studies including population counts, germination trials, identification of natural pollination rates and, where this is lacking, the advent of hand pollination trials.

Thumbnail 1

The White-winged Chough has had a substantial impact on orchid populations, which are selectively dug up and eaten. Most affected have been spider-orchids and colony-forming greenhoods and helmet-orchids. The chough density is over four times the natural density supported by box-stringybark woodland ecosystems away from settlement in NEM (e.g. One Tree Hill). This is for a number of reasons, the foremost of which is that they prefer open ground. Their omnivorous (generalist) diet and territorial/communal behaviour has been favoured by past management. Their size and intelligence has ultimately enabled them to dominate. Grassy shrubland species have declined because they are smaller, have more specialised feeding requirements, are predation-prone (e.g. vulnerable due to loss of cover) or timid. These include the Painted Button-quail, White-throated Nightjar, Bassian Thrush, Spotted Quail-thrush and Speckled Warbler. The contributing reasons for the population expansion of choughs include:

- prior logging/soil erosion: the denuded exposed hill-slopes and lack of grasses has favoured open ground generalists over grassy shrubland specialists.
- prior land-clearing/habitat fragmentation: an ability to exploit the high interface of edge habitat as a supplementary feeding resource while having the bushland as the principal feeding and nesting habitat.
- an ability to adapt to and exploit the nature of the bushland settlement at Dunmoochin. Note that the White-winged Chough has been eliminated from the alluvial and volcanic plains of NEM because it is unable to survive the urban presence or heavy land clearing. Without these pressures at Dunmoochin they have benefited from humans for supplementary food and dams for nest building and bathing.

Thumbnail 2

Revegetation of cleared farmland

Many of the ecological imbalances have been caused by bushland fragmentation. From the air, Dunmoochin can be seen as a narrow strip of bushland west of the ridge along Dunmoochin Road plus two bushland annexes to the east. Surrounding land clearing has produced a high ratio of perimeter habitat. The bushland supports open country ('fragmentation') flora and fauna species such as Australian Magpies. As part of a program of conserving or bringing back the bushland ground flora and fauna, several of the cleared enclaves on the periphery of Dunmoochin are being revegetated. This is increasing the effective area of bushland habitat as well as reducing the 'fragmentation boundary'. The revegetation areas are drawing fragmentation species, including the White-winged Chough and Eastern Grey Kangaroo, away from the sensitive orchid areas in the interior of Dunmoochin.

The vegetation structure and floristics of these areas as they mature will approximate that of Dunmoochin prior to logging and land settlement disturbance. With the replanting of species such as Yellow Box, which has been

selectively logged, and Golden Wattle, which is now virtually absent from the regrowth bushland, the revegetation areas will support additional fauna species. These will likely include birds favouring gum-barked woodlands such as the White-throated Gerygone and Crested Shrike-tit, shrubland birds such as the Rufous Fantail and many species of butterflies.

This is already occurring in several sections, particularly the Tom Uren Bird Sanctuary in which planting commenced in 1990. A focus in the sanctuary has been the provision of shrub 'copses', important for nesting birds. Most importantly, the revegetation areas may provide necessary habitat links for several faunal species such as the Tree Dragon and Brush-tailed Phascogale. These have become rare due to habitat fragmentation and housing settlement.

The planting of shrubs and natural regeneration of native herbs such as the Wattle Mat-rush and Weeping Grass in the Tom Uren Bird Sanctuary quickly provided breeding habitat for several butterfly species. These included Satyrinids (e.g. Common Brown, Shouldered Brown, Klugs Xenica and Eastern Ringed Xenica), Lycaenids (e.g. Double-spotted Line Blue and Common Imperial Blue) and Hesperids (e.g. Phigalia Skipper). In recent years the establishment of Black Wattle and Sweet Bursaria and the flowering of Golden Bush-pea, Woolly Wattle and Clustered Everlasting has provided breeding and feeding habitat for additional butterflies (e.g. Pea Blue and Common Imperial Blue) and native bees, which are important orchid pollinators.

The increasing diversity and abundance of insects has attracted a greater diversity of insectivores. The Grey Shrike-thrush, Golden Whistler, Weebill, Buff-rumped Thornbill, Brown Thornbill and Striated Thornbill were among the first to breed in the sanctuary.

A major change occurred in the sanctuary in the sixth year (1996). Shrubs commenced regular flowering and had structurally filled out. The winter insectivore guild of the local bushland (described earlier) fully expanded into the sanctuary in response to the development of the middle shrub layer. Superb Fairy-wrens commenced breeding. They are rare in the Dunmoochin bushland. The Speckled Warbler and Yellow Thornbill were also seen for the first time. Copses of wattles interspersed with tussock grasses provide wintering areas for these and other insectivores such as the Grey Fantail and Scarlet Robin, which visit from their spring nesting areas in nearby gullies.

Honeyeaters (White-naped, Brown-headed and White-eared Honeyeater and the Eastern Spinebill) commenced visiting the maturing shrubs and a pair of Yellow-faced Honeyeaters nested. Shining Bronze-Cuckoos were noticed for the first time in the sanctuary in mid-spring 1996, attracted by the breeding activity of thornbills. Common Bronzewing and Little Corellas visited the sanctuary in November/December 1996 for seeds of the Golden Wattles. The next five years will provide further changes and additional species.

Planning Recommendations

Dunmoochin Environmental Living Zone. Environmental living is a category of land-use zoning adopted by the Shire of Nillumbik in their planning scheme to meet the dual aims of wildlife conservation and residential land-use in the Bend of Islands Environmental Living Zone and Round the Bend Cooperative. The objective of the Environmental Living Zone (as stated in the Shire of Healesville Planning Scheme, 1976 Interim Development Order, p. 56) is as follows:

Management controls will be implemented to maintain and enhance the positive environmental qualities of landscape vegetation, habitat for native flora and fauna, and to protect specific sensitive areas from damage to the natural systems, consistent with the protection of existing occupation.

The Dunmoochin Conservation Area contains superior biological values while conservation attitudes and practices are comparable with those in the Bend of Islands ELZ. Dunmoochin supports almost the entire known population of one of Victoria's most endangered species, the Rosella Spider-orchid, and the largest known population of another, the Crimson Spider-orchid. The areas containing these species should be considered for designation as Critical Habitat under the State Government Flora and Fauna Guarantee Act. Further, over 50% of Dunmoochin is placed under conservation covenants and much of the remaining land is managed according to conservation guidelines. The stated purposes of the conservation covenants are consistent with the purposes of an Environmental Living Zone. Aggregations of covenanted private land of very high biological significance such as Dunmoochin should satisfy eligibility criteria for an Environmental Living Zone.

Critical Conservation Area—Rosella Spider-orchid. The designation of a Rosella Spider-orchid Critical Conservation Area would help consolidate all existing and potential areas of its occurrence in the site under conservation management (in accordance with the Regional Habitat Link Strategy). The strategy contains specific guidelines for retaining and enhancing the most critically important stands (and their indigenous understorey vegetation) of threatened habitats and endangered/vulnerable orchid species in NEM. Any proposed permit for subdivision in the Critical Conservation Area would require a full Environmental Impact Assessment. The Regional Habitat Link Strategy requires the protection of all Critical Conservation Areas in NEM and conservation controls to manage their designated biological values appropriately.

Site 69 Pittles Paddock

Map Reference:	7922 417364 (Pittles Paddock grassy/gully woodland census plot); 7922 424356 (Old Cottles Bridge–Strathewen Road grassy/gully woodland census plot). One minute lat/long grids include 37° 36' x 145° 11' to 145° 12'.
Location/Size:	Land between the Cottles Bridge–Strathewen Road and Mine Road, centred on Barreenong Road, Cottles Bridge. Approximately 140 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: road reserve (Old Cottles Bridge–Strathewen Road, Cottles Bridge–Strathewen Road, Mine Road and Barreenong Road). Private: bushblocks and farmland, predominantly livestock grazing and some orchards.
Landforms:	Elevation is 110–190 m.

Scientific and Educational Values

Scientific reference. Grassy/gully woodland census plots at Pittles Paddock and along the Old Cottles Bridge–Strathewen Road.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: nil

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark grassy woodland (14.6)

Partially intact or small stands: Swamp Gum gully woodland (10.3); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Stringybark box–stringybark woodland (11.3); Yellow Box–Candlebark valley forest (31.1)

Critical assemblages or populations: stand of about 15 ha of Yellow Box–Red Stringybark box–stringybark woodland with moderately intact shrub and field layers at Pittles Paddock; most extensive remaining in the lowland hills

Notable features: Swamp Gum gully woodland below the Old Cottles Bridge–Strathewen Road contains moderately intact shrub layers and a field layer of Tall Sedge and Sword Tussock-grass. Seasonally inundated freshwater meadow (formerly under Swamp Gum gully woodland) dominated by Common Tussock-grass, Slender Tussock-grass, Tall Sedge and Common Sedge in the valleys at Pittles Paddock are important breeding areas for Satyrinid (brown) butterflies.

FAUNAL SIGNIFICANCE: Site 69 Pittles Paddock

Assessment: State—Category 2 (B, D, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

69^a: 37° 36' x 145° 12'; Pittles Paddock and Cottles Bridge–Strathewen Road

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 69^a: Swift Parrot, Ictinus Blue butterfly

c. Rare fauna

Regional. 69^a: Barking Owl, Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 69^a: 11 species at the Pittles Paddock grassy woodland census plot in October 1990

i. Arboreal mammals

Local. 69^a: 3 species including the Sugar Glider while spotlighting Pittles Paddock on 1 November 1991

j. Ground mammals

Local. 69^a: 4 species including the Common Wombat and Black Wallaby while spotlighting Pittles Paddock on 1 November 1991

k. Frogs

Regional. 69^a: 7 species including the Victorian Smooth Froglet and Bibron's Toadlet in the valley below the Old Cottles Bridge–Strathewen Road on 29 May 1993

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 69^a: over 135 species

b. Native birds

State. 69^a: over 110 species

c. Native mammals

Regional. 69^a: 11 species

d. Herpetofauna

Regional. 69^a: 15 species

f. Butterflies

Regional. 69^a: 26 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 69^a: 33 species

b. Regionally endangered fauna (R1 species)

Regional. 69^a: 3 species. **Birds:** Western Gerygone. **Reptiles:** Eastern Bearded Dragon. **Butterflies:** Ictinus Blue

c. Regionally vulnerable fauna (R2 species)

State. 69^a: 10 species. **Birds:** Crested Pigeon, Barking Owl, White-throated Nightjar, Black-eared Cuckoo, Red-capped Robin, Hooded Robin, White-throated Gerygone, Brown Treecreeper, Fuscous Honeyeater. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 69^a: 6 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift, Pink Robin, Spotted Quail-thrush, Masked Woodswallow, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

State. 69^a: 14 species. **Birds:** Latham's Snipe, Peregrine Falcon, Barking Owl, Australian King-Parrot, Swift Parrot, Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Bassian Thrush, Speckled Warbler, Rufous Songlark. **Frogs:** Bibron's Toadlet. **Butterflies:** Spotted Brown, Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 69^a: 16 species. **Birds:** Painted Button-quail, Brush Bronzewing, Australian Shelduck, Little Eagle, Australian Hobby, Barn Owl, Rainbow Lorikeet, Little Lorikeet, Long-billed Corella, Red-browed Treecreeper, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink. **Butterflies:** Phigalia Skipper, Bank's Brown, Meadow Argus

F. POPULATION DENSITY: Viability and Abundance—point census

m. Regionally rare fauna (R3 species)

Regional. 69^a: flock of 40 White-browed Woodswallows and 10 Masked Woodswallows roosted overnight on 17 October 1989 in a large, spreading Red Stringybark on the sheltered hill-slopes of Pittles Paddock

o. Regionally restricted fauna (R5 species)

Regional. 69^a: 10 Long-billed Corellas feeding on ripened seeds of Austral Crane's-bill in an open section of Pittles Paddock on 31 March 1992

Outlook

The significance of Pittles Paddock is largely due to the avifauna. As long as it remains ungrazed by livestock, allowing natural regeneration to proceed it should maintain state faunal significance. The effects of proposed bushblock subdivision will pressure faunal values (see ecological imbalance of bushland refugia due to fragmentation and human settlement in the Dunmoochin site).

FAUNA

Rare or Threatened Fauna

Bb 69^a: Swift Parrot. Three visited Yellow Box–Candlebark grassy woodland (14.6) in the valley of Pittles Paddock on 21 April 1993. They fed on leaf psyllids. Swift Parrots are rare in the Nillumbik Lowland Hills.

Bb 69^a: Ictinus Blue butterfly. A population of 25–30 adults was located at Pittles Paddock in early March 1993 (Yellow Box–Red Stringybark box–stringybark woodland; 11.2). Over 50 late instar larvae, attended by the Meat Ant, were counted in a stand of Black Wattles on 20 December 1993. The ant is heliothermic (requires sun to emerge). During the following 8–10 days of wet weather many of the larvae perished. The weather kept the Meat Ant indoors and larvae possibly fell prey to insectivorous birds. Honeydew secreted by the larvae is removed by the ants. In their absence, damp conditions caused a fungal epidemic to run through most of the larvae. Some that survived were parasitised by Braconid wasps.

Only two or three adults were recorded in February/March 1994. Successive wet years in 1995 and 1996 have depleted the Meat Ant colonies and eliminated the butterfly. At the southern end of the butterfly's range near Melbourne, cool and damp weather is a major limiting factor. Dampness, exacerbated by Echidna digging, has caused most of the ant colonies to be abandoned. It is possible that a small population of the butterfly survives locally, and numbers can rebuild. Colonies are mobile and seldom persist for more than five years. This is related to a dependence on mid-succession Black Wattles. The three known colonies in NEM occur in open, exposed situations containing Black Wattle regenerated from disturbance episodes in the late 1970s (see site 42).

Bc 69^a: Brush-tailed Phascogale. A road-killed male was found on the Cottles Bridge–Strathewen Road near Barreenong Road on 4 April 1987. Roadside vegetation was Yellow Box–Red Stringybark box–stringybark woodland (11.2). Several have been picked up as road-kills in NEM around this time. After reaching independence, males become free-ranging. They will cross open country and are subject to predation from cats and foxes.

Bc 69^a: Barking Owl. One heard in Yellow Box–Red Stringybark box–stringybark woodland (11.2) at Pittles Paddock on 1 November 1991. They bred at Dunmoochin in 1989 but appear to have shifted in 1991 to Pittles Paddock, where rabbits were more common.

Other Significant Fauna

Birds

- Eb* **69^a: Western Gerygone.** A pair in Yellow Box–Red Stringybark box–stringybark woodland (11.2) below Barreenong Road (1989/90 bird census plot) on 6 November 1995. A nest containing several eggs was located in a Black Wattle. This inland species is very rare in NEM, with only one other breeding record in the last decade. An annual spring–summer migrant from northern Australia to box–stringybark/ironbark woodlands in northern Victoria, it rarely enters southern Victoria. The open woodland of Pittles Paddock is structurally similar to vegetation of north-central Victoria.
- Eb* **69^a: Eastern Bearded Dragon.** One along Barreenong Road near Pittles Paddock in 1992 (Randall Robinson pers. comm.). The subspecies was not determined and animals are occasionally released or escape from captivity. If it was the subspecies *vitticeps* ('beard' extending along the side of the neck), it was probably a natural occurrence as the subspecies occurs in box–stringybark woodland in GM and was recorded nearby at Rankins Road Strathewen. This subspecies is not as often kept in captivity as the subspecies *barbatus* (native to northern Victoria). Pittles Paddock is an important area for Tree Dragons, Lowland Copperheads and Eastern Brown Snakes. These species live in the old rabbit burrows and under the piles of uprooted stumps. Each has become scarce in more densely settled parts of the lowland hills. Delicate Skinks are relatively common in the damp, grassy sections of the valley and Bougainville's Skinks inhabit the loose sandstone rock areas of the exposed hill-slopes of Pittles Paddock.
- Ec* **69^a: Crested Pigeon.** One seen along Barreenong Road in Yellow Box–Red Stringybark box–stringybark woodland (11.2) by Pittles Paddock on 10 March 1992. This is the only locality east of Arthurs Creek in NEM where the species has been recorded. Populations are otherwise restricted to the Plenty Plains and Hills.
- Ec* **69^a: White-throated Nightjar.** One heard calling at dusk on 1 November 1991. They have not been recorded at nearby Dunmoochin in recent years. This species has become very rare in the lowland hills due to land clearing and cat and fox predation. Pittles Paddock is the last remaining area of Yellow Box–Red Stringybark box–stringybark woodland (11.2) in NEM where it has been recorded.
- Ec* **69^a: Black-eared Cuckoo and Red-capped Robin.** The Yellow Box–Red Stringybark box–stringybark woodland (11.2) of Pittles Paddock supports an assemblage of semi-arid shrub layer insectivores. These are representative of mallee shrublands and box–ironbark woodlands of inland Victoria and are now rare in GM due to land clearing. An adult Black-eared Cuckoo was recorded at the census plot on 17 October 1990. It was gleaning caterpillars amongst a Black Wattle thicket and also scanned from a low bare branch to pounce on ground invertebrates in the manner of the Red-capped Robin. This was near a pair of Speckled Warblers which had built a dome-nest of grass, bark and down, well-hidden under a grass tussock amongst fallen wattle branches. Apparently the Black-eared Cuckoo had also located the nest. On a return visit on 10 November 1990, a juvenile cuckoo was sitting on a low branch in the thicket being fed by the warblers.

The Red-capped Robin was breeding at Pittles Paddock in the consecutive census years (October 1989 and 1990). The habitat contained scattered thickets of dense shrubs (Black Wattle, Hedge Wattle and Burgan). The ground consisted of stands of Kangaroo Grass interspersed with patches of bare ground where the robin hunted and stumps and fence posts where it scanned for prey. The nests were well-camouflaged cups of grass, shredded bark and lichen. In both years they were lodged in a concealed branch-fork amongst a Gold-dust Wattle thicket.

- Ec* **69^a: Brown Treecreeper.** Up to three birds in Yellow Box–Candlebark grassy woodland (14.6) at the Pittles Paddock census plot in October 1989 and 1990. This is the last surviving population in the Shire of Nillumbik and one of few in NEM. They appear to have become extinct recently in the Plenty Gorge and are likely to become extinct in the Nillumbik Lowland Hills in the next few years. Similar to the Black-eared Cuckoo and Red-capped Robin, they inhabit areas containing grass tussocks, scattered shrubs and ample litter, fallen logs and bare ground.

The Brown Treecreeper is sedentary and communal. Colonies are composed of a breeding female with a company of several males. The colony maintains a year-round territory. They feed on bark and crevice invertebrates, particularly ants, from fallen logs and the lower part of tree trunks (e.g. loose bark on the mid-bole or around the base of Yellow Box). At Pittles Paddock they also spend a considerable amount of time

foraging amongst leaf litter and twigs for ground invertebrates under tall shrubs such as Golden and Black wattles.

Clearing, grazing and degradation of box-stringybark woodland habitat and removal of fallen logs since settlement has severely fragmented populations of the Brown Treecreeper. They continue to decline despite no further substantial loss of habitat. This ground-dwelling species is probably now succumbing to cat and fox predation and human disturbance. In order to survive, it requires management such as predator control, fencing of broad revegetation zones to regenerate tall shrubs and replenishment of fallen logs.

Ec **69^a: Fuscous Honeyeater.** Two on the sheltered hill-slopes of Pittles Paddock in flowering Red Stringybark herb-rich foothill forest (6.1) on 22 March 1992. They irrupt in autumn-winter into the lowland hills of NEM from northern Victoria every few years.

Ed **69^a: Latham's Snipe.** Two present after a rainy period in freshwater meadow in the valley of Pittles Paddock (ex-Swamp Gum gully woodland; 10.3) on 10 January 1991.

Ed **69^a: Pink Robin.** One in Yellow Box-Red Stringybark box-stringybark woodland (11.2) at Pittles Paddock amongst a copse of Black Wattles below Barreenong Road on 22 March 1992.

Ed **69^a: Spotted Quail-thrush.** Two drinking at a dam by Barreenong Road on 10 March 1992. They were subsequently recorded in Yellow Box-Red Stringybark box-stringybark woodland (11.2) at Pittles Paddock on 31 March. The quail-thrush are autumn-winter visitors from the ranges. For decline in the lowland hills see White-throated Nightjar (above).

Ed **69^a: White-browed and Masked Woodswallow.** A flock of 40 White-browed and 10 Masked Woodswallows were recorded on 17 October 1989 during the grassy woodland census of Pittles Paddock. Pittles was the last census plot of the day. The woodswallows had been overhead for much of the afternoon. As dusk approached the birds confined their activities to a small area over the sheltered hill-slopes on the north-western side of the valley (Red Stringybark herb-rich foothill forest; 6.1). The birds were spiralling and wheeling lower and lower above the tree-tops and appeared to be preparing to roost.

In a split second they dropped out of the sky in unison. They were located on the mid-slope as they were still engaged in high-pitched chatter and the occasional bird would break into the air. They roosted in pairs and small groups in the leafy upper canopy branches of a large Red Stringybark. About 30 minutes after first light the following morning the birds took to the air. They circled over Pittles Paddock for 20 minutes while the bird census was being conducted, and then departed, possibly for a nesting destination along Diamond or Arthurs Creek.

Ee **69^a: Bassian Thrush.** Single bird amongst a copse of Burgan in Yellow Box-Candlebark grassy woodland (14.6) in the valley of Pittles Paddock on 31 March 1992. Like the Spotted Quail-thrush, they are autumn-winter visitors from the ranges. Both ground species are afflicted by fox/cat predation.

Ef **69^a: Painted Button-quail.** A male with three young was in Yellow Box-Red Stringybark box-stringybark woodland (11.2) at Pittles Paddock on 1 November 1991.

Eg **69^a: Nesting Wedge-tailed Eagle.** A pair nested in an old eyrie in a Candlebark (Yellow Box-Candlebark grassy woodland; 14.6) in the valley behind the Nicholls property in spring 1993 but failed to rear any young (Felicity Nicholls pers. comm.). This pair nested above the lower Stewart Ponds Creek (site 66) in spring 1991 and 1994. In 1995, they moved back to site 69 where they nested in a Yellow Box in Pittles Paddock (about 500 m north-east of where they nested in 1993). Incubation commenced in early September and the young hatched around mid-October. Two young were successfully reared.

The territory of this pair, of the order of 1000 ha, includes the Arthurs Creek/Stewart Ponds Creek valley and the adjoining section of the Diamond Creek valley. During the 1995 breeding season the hunting range was confined mainly to site 69 and the adjoining site 68 (Dunmoochin). They less frequently extended over the 1994 hunting area along the middle and upper reaches of Stewart Ponds Creek. Most days of summer 1995/96 they were seen soaring in the mid-afternoon thermals over the ridgeline of Dunmoochin. On 11 January 1996, the pair took the young on their first tour of the territory, the young constantly shrieking and keeping close behind the adults.

69^a: Valley forest/gully woodland bird census: Pittles Paddock. Ten 2 ha/20-minute counts were conducted in October 1989/90. The census consisted of two 250 m transects each 40 m wide. The strip flanked a dry creek which had been cleared of tree and shrubland vegetation.

Degree of fragmentation: low (one side open paddocks, three sides connect forest). Degree of thinning: medium (tree density of 140/ha). Degree of understorey and ground degradation: low (moderately intact shrubland and grassland).

Vegetation. Both transects occurred in Yellow Box–Candlebark grassy woodland. The first occupied the narrow upstream section of the valley where sheltered hill-slopes of Red Stringybark herb-rich foothill forest (6.1) come into close contact with exposed hill-slopes of Yellow Box–Red Stringybark box–stringybark woodland (11.2). The second transect flanked the broader downstream section of the valley. Trees/ha (20% cover): 80 Yellow Box, 28 Long-leaf Box, 25 Red Stringybark, 3 Narrow-leaf Peppermint, 3 Candlebark and 1 Messmate. Tall shrubs (10% cover); low shrubs (10% cover); herbs (50% cover).

Results. Bird summary: 64 species and 974 individuals recorded (23 forest, 21 woodland, 12 shrubland and 7 fragmentation species); 48.7 birds/ha composed of 27.4 (57%) forest, 11.0 (23%) woodland, 7.5 (15%) shrubland and 2.8 (5%) fragmentation birds.

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (4.7), Buff-rumped Thornbill (4.2), White-naped Honeyeater (3.5), Spotted Pardalote (2.8), Weebill (2.7), Rufous Whistler (1.9), Varied Sittella (1.2), Gang-gang Cockatoo (1.0), Brown-headed Honeyeater (0.8), Scarlet Robin (0.8), Masked Woodswallow (0.6), Shining Bronze-Cuckoo (0.5), White-throated Treecreeper (0.5), Olive-backed Oriole (0.5), White-winged Chough (0.5) and Grey Currawong (0.5).

Woodland species with densities exceeding 0.5/ha included the White-browed Woodswallow (3.0), Striated Pardalote (1.3), Eastern Rosella (0.9), Dusky Woodswallow (0.7), Black-faced Cuckoo-shrike (0.6), Brown Treecreeper (0.6) and Fan-tailed Cuckoo (0.5).

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (3.6), Grey Fantail (0.8), Speckled Warbler (0.6), Silvereeye (0.6), Superb Fairy-wren (0.6) and Golden Whistler (0.5).

Fragmentation species with densities exceeding 0.5/ha included the Yellow-rumped Thornbill (1.0), Australian Magpie (0.8) and Little Raven (0.7).

Parrots: 6 species and 2.8 birds/ha. **Canopy insectivores—migratory:** 19 species and 10.1 birds/ha; **non-migratory:** 9 species and 20.5 birds/ha.

Discussion. 48.7 birds/ha, 30.6 of which were tree canopy insectivores (dieback control agents; high diversity and numbers). The tall thickets of Burgan and Black Wattle and regenerating eucalypts were important for the shrub layer birds. Pittles Paddock was the only census plot adjoining Yellow Box–Red Stringybark box–stringybark woodland. It contained several character shrubland species of this habitat which were rare or absent from the other census plots. These included the Black-eared Cuckoo, Red-capped Robin and Hooded Robin. It was the only census plot containing the Brown Treecreeper. A breeding pair of Speckled Warblers was present. Breeding pairs of Satin and Leaden Flycatchers were recorded at the upper transect in 1990. The Satin Flycatcher nested in 6.1 while the Leaden Flycatcher nested in 14.6. This illustrates the forest to woodland faunal transition at Pittles Paddock.

Conclusion. The extensive stand of Yellow Box contained the highest migratory canopy insectivore diversity and density of the 16 census plots. Habitat links for birds are effective. The tall shrub layers contained several rare shrubland species. Forest fragmentation through subdivision would increase the occurrence of fragmentation species and leaf insect defoliation.

69^a: Valley forest/gully woodland bird census: Old Cottles Bridge–Strathewen Road at Cottles Bridge. Ten 2 ha/20-minute counts were conducted in October 1989/90. The census plot was a 500 m transect 40 m wide. The strip flanked a dry creek below the Old Cottles Bridge–Strathewen Road.

Degree of fragmentation: high (three sides open paddocks, one side connects forest). Degree of thinning: high (tree density of 110/ha). Degree of understorey and ground degradation: medium (sparse shrub layer and moderately intact field layer, dissected by roadways).

Vegetation. Gully supporting Swamp Gum gully woodland (10.3) flanked by a valley of Yellow Box–Candlebark valley forest (31.1). Copses of tall shrubs (Blackwood) and a dense native field layer (Sword Tussock-grass) were present. Trees/ha (15% cover): 35 Candlebark, 23 Yellow Box, 22 Swamp Gum, 20 Long-leaf Box, 5 Narrow-leaf Peppermint and 5 Red Stringybark. Tall shrubs (10% cover); low shrubs (5% cover); herbs (70% cover).

Results. Bird summary: 50 species and 478 individuals recorded (15 forest, 15 woodland, 9 shrubland and 11 fragmentation species); 23.9 birds/ha composed of 5.7 (24%) forest, 6.1 (26%) woodland, 3.1 (13%) shrubland and 9.0 (37%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Buff-rumped Thornbill (1.1), Spotted Pardalote (0.8), White-naped Honeyeater (0.6), Grey Currawong (0.6), Weebill (0.6) and Rufous Whistler (0.5)

Woodland species with densities exceeding 0.5/ha included the White-plumed Honeyeater (1.4), Striated Pardalote (1.3), Eastern Rosella (1.0) and Black-faced Cuckoo-shrike (0.5)

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (1.3) and Superb Fairy-wren (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Common Starling (1.9), Noisy Miner (1.8), Australian Magpie (1.2), Yellow-rumped Thornbill (1.0), Australian Magpie-lark (0.9), Little Raven (0.7) and Common Myna (0.7)

Parrots: 3 species and 1.4 birds/ha. **Canopy insectivores -migratory:** 12 species and 2.5 birds/ha; **non-migratory:** 7 species and 4.9 birds/ha

Discussion. 23.9 birds/ha, 7.4 of which were tree canopy insectivores (dieback control agents). This was one of only four plots where fragmentation species were the dominant avian group.

Conclusion. The plot lacks effective habitat links. The high level of bushland fragmentation has reduced the populations of canopy species and raised populations of fragmentation species. The linear nature of the forest stand has enabled a colony of Noisy Miners to establish. The lack of foliage birds was partially due to the aggressive behaviour of this species. Insect leaf defoliation was apparent.

Butterflies

Df **69^a: Pittles Paddock–Old Cottles Bridge–Strathewen Road.** Twenty-six breeding species recorded. The most productive areas are the valley (Swamp Gum gully woodland; 10.3) and exposed hill-slopes (Yellow Box–Red Stringybark box–stringybark woodland; 11.2) of Pittles Paddock and the Sweet Bursaria and Prickly Tea-tree along the Old Cottles Bridge–Strathewen Road (Yellow Box–Candlebark valley forest; 31.1), particularly when flowering in January. The latter is also a fine area for Jewel Beetles (over 20 species recorded; Fabian Douglas pers. comm.).

Significant species:

- Doubleday's Skipper: flowering Burgan along the Old Cottles Bridge–Strathewen Road in late November 1993; undergoing a local range expansion
- Phigalia Skipper: both areas in October/November
- Phigalioides Skipper: flowering Yellow Box along the Old Cottles Bridge–Strathewen Road in December 1991
- Symmomus Skipper: late March 1993 along the Old Cottles Bridge–Strathewen Road; breeding in Spiny-headed Mat-rush
- Imperial White: several colonies on Drooping Mistletoe and Creeping Mistletoe on Red Stringybark and Long-leaf Box along the Old Cottles Bridge–Strathewen Road; larvae present in December 1991
- Spotted Brown: single male seen in the headwaters of the main gully of Pittles Paddock in March 1993; stands of the larval food-plant (Slender Tussock-grass) are present
- Meadow Argus: recorded in both areas in November/December
- Blue Jewel: one in flowering Yellow Box on the Old Cottles Bridge–Strathewen Road in December 1991
- Common Imperial Blue: a population of over 100 along the Old Cottles Bridge–Strathewen Road in Hill Silver Wattle (dwarf suckering form of Silver Wattle)
- Common Dusky Blue: flowering Sweet Bursaria along the Old Cottles Bridge–Strathewen Road in late January 1993; breeds locally on Downy Dodder-laurel.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. There is an intact link south to the Dunmoochin site, and partial links east to the Cottles Bridge to St Andrews site and west to the Hurstbridge to Arthurs Creek site.	
<p>Grassy/box–stringybark woodland dieback–habitat link severance. Dieback of Yellow Box, Red Stringybarks and Narrow-leaf Peppermints is a widespread problem in the district, particularly for isolated trees in grazed farmland and stands that have become fragmented by land clearing. Livestock tend to camp under these broad-canopied trees. This has led to severe soil compaction and nutrient enrichment, weed invasion, ringbarking and loss of shrubs (e.g. Sweet Bursaria). The stress placed on the trees in combination with the depleted shrub layers and lack of foliage birds has led to foliage insect damage, branch dieback and death in extreme cases (particularly of Red Stringybarks). Decline of Red Stringybarks from Cinnamon Fungus is a related problem arising from land-use, particularly soil disturbance from earthworks and altered drainage patterns.</p>	<p>Strengthen habitat links.</p>

Road-killed wildlife. There is a heavy toll of road-killed wildlife along the bitumen Cottles Bridge–Strathewen Road, which presents a partial barrier to the movement of ground fauna. The valley along which the road runs is a faunal corridor and crossings occur at several points (e.g. near the entrance of the Old Strathewen Road and at the foot of the cutting before Barreenong Road where a male Brush-tailed Phascogale was picked up in April 1987). Barreenong Road also contains an important crossing point connecting the Cottles Bridge–Strathewen Road valley and Pittles Paddock. This is on either side of a blind bend, a few hundred metres from the north end of Barreenong Road.

Increasing traffic and excessive vehicle speeds. Reducing vehicle speed and travel employs the principle of time management (another word for conservation). The fast through traffic along the Cottles Bridge–Strathewen Road is often outlying residents at Arthurs Creek and Strathewen, attempting to make up time. Many of the fastest drivers along gravel roads are hurrying local residents. Developments along gravel roads such as the proposed fun park at Mine Road present a direct threat to roadside flora (particularly through dust) and fauna. Also there is the indirect threat of road widening and straightening, and loss of roadside values.

Drivers need to exercise a 40 km/hr speed limit on gravel roads and slower speeds at animal crossing points and near houses. On the bitumen Cottles Bridge–Strathewen Road there should be a maximum speed limit of 75 km/hour. Animal crossing points should be posted with signs requesting drivers to be on the alert for these and reptiles such as blue-tongued lizards, which sun on the warm road surface. Road mortality is becoming a significant threat for ground fauna, particularly large herpetofauna species such as snakes and blue-tongued lizards and Black Wallabies, Echidnas and Wombats. Eastern Grey Kangaroos, which are locally proliferating, present a threat to the lives of occupants of speeding cars (see volume 1).

Regional Hydrological Strategy

Farm dam proliferation. Dams built after land subdivision over the last two decades have had a major impact on loss of flow and water pollution of stream and seasonally inundated freshwater meadow ecosystems in valleys throughout the foothills of NEM. This impact is in critical need of assessment as land subdivision and dams proliferate to an extent that may lead to collapse of the native stream ecosystems. The sections of Arthurs Creek and Diamond Creek immediately downstream of the site are among the most severely threatened in NEM. The dams are usually placed at the break of slope between the hills and valleys, which contain freshwater meadow habitats and rare plant species. Pittles Paddock contains one of few extensive stands of grassy woodland in NEM that has not been subjected to heavy livestock grazing in recent decades. The freshwater meadows in the valley of Pittles Paddock form feeding habitat for the migratory Latham's Snipe. Dam development and livestock grazing is eliminating this habitat throughout NEM.

Failed dams. Many of the valley dams in the siltstone/sandstone areas of the Cottles Bridge and Arthurs Creek districts have failed. Grey loam topsoil from the outwash of eroding hill-slopes has developed to several metres depth in broad valleys. Most dams are located in these areas. Steep slopes forming dam catchments are generally grazed. Loss of vegetation and soil compaction caused by stock has caused less water infiltration into the soil and a higher rate and velocity of runoff. This has led to gully erosion and dam siltation. The pressure of incoming high velocity water into dams finds weaknesses in the wall which eventually breach. This creates a major erosion problem locally and a siltation problem in the creeks and freshwater meadows downstream.

Gully management and farm dams. The health of local streams cannot improve without careful conservation management of local catchments. Herbfields at the junctions of valleys, which are collecting areas for seepage from the hills, the principal source of water fed into streams over critical summer low flow periods, need to be protected from livestock grazing. New farm dams should require a permit that includes safeguards such as partial fencing to enable gully revegetation.

Most failed dams have used porous grey loam in the interior of the wall. There is not enough impermeable yellow clay subsoil locally available for an entire wall of a large dam, unless well designed and constructed. A core trench into the yellow clay subsoil under the wall is essential and a shallower bodied dam should be constructed, with the alluvium used as a veneer for grass cover over the face of the wall. Breached dams should be back-filled and replanted with gully woodland vegetation.

Other Issues

Clearing at Pittles Paddock in the 1970s.

About 10 ha of Yellow Box–Red Stringybark box–stringybark woodland along Barreenong Road was cleared. Stumps were removed to enable contour ripping of the hill-slope. This led to a cycle of rabbits, erosion, foxes and loss of wildlife. The earthworks led to Blackberry, Panic Veldt Grass, Sweet Vernal-grass, Brown-top Bent and Yorkshire Fog taking over the valley and gully herbfields.

Rabbit populations entrenched, leading to sheet erosion on the upper hill-slopes and tunnel erosion in the gullies and suppressing shrub and field layer regeneration. Increased fox populations through the 1980s and 1990s reduced the rabbits. The foxes live in old rabbit warrens. They have preyed on native ground fauna and have depleted populations of the Painted Button-quail, Bassian Thrush, Spotted Quail-thrush, White-throated Nightjar, Brown Treecreeper and Tree Dragon. Extensive regeneration has since occurred.

Weed removal. The Dunmoochin LandCare Group conducts weeding patrols and replanting along Barreenong Road. Montpellier Broom, Cootamundra Wattle and Monterey Pine have been targeted. The roadside of the Old Cottles Bridge–Strathewen Road also needs weeds removed, particularly Spanish Heath and Montpellier Broom. Spraying Blackberry in the valleys and gullies at Pittles Paddock would facilitate recolonisation by the Bank’s Brown and Spotted Brown butterflies.

NLH C HURSTBRIDGE

This management unit consists of one site of state significance (site 71) and four sites of regional faunal significance (sites 70, 72, 73 and 74) and surrounding land that forms habitat links.

Map Reference: 7922 419274 to 7922 387344 (southern to northern point) and 7922 356323 to 7922 443318 (western to eastern point).

Location/Size: The catchments of Diamond Creek between Shrubby Creek and the confluence of Diamond and Arthurs creeks in an area bounded by Yan Yean Road in the west, Bannons Road/Haleys Gully Road and Cherry Tree Road in the north, Kangaroo Ground–St Andrews Road in the east and Ironbark Road and the Wattle Glen to Kangaroo Ground Road in the south. Approximately 2000 ha.

Municipality: Shire of Nillumbik..

Physical Features

The management unit lies in the foothills of the Eastern Uplands and includes a large section of the middle reaches of Diamond Creek. A broad floodplain developed at the confluence of Diamond Creek and Arthurs Creek. Extensive colluvial outwash deposits have developed in the broad valleys and hill-slopes that occur along the eastern tributaries. Ridgelines occur on the western, northern and eastern boundaries (Ironbark/Yan Yean roads, Haleys Gully/Cherry Tree roads and Kangaroo Ground–St Andrews Road respectively). The former separates the Plenty River catchment to the west and the latter the Watsons Creek catchment to the east.

The geology east of Diamond Creek is of Silurian siltstone/mudstone, associated with the St Andrews anticline. The geology west of Diamond Creek is mostly sandstone/shale, associated with the Greensborough syncline. The only substantial tributary west of Diamond Creek is Scrubby Creek, which drains the area between Ironbark Road and Bannons Road. Smaller creeks drain the catchments east of Diamond Creek (Watery Gully and Cherry Tree creeks).

Landforms

Foothill: ridges, hill-crests, hill-slopes, gullies, valleys, creeks, streams, dams and goldmine. Alluvial plain (restricted to the floodplain of Diamond Creek): plain-slopes and stream floodplain, freshwater meadows and floodplain ponds. Elevation is 60–220 m.

Hydrology

Diamond Creek below Arthurs Creek is perennial and contains slow-moving and deep open water pools and faster-moving rocky/sandy riffles. Both Arthurs Creek and Diamond Creek above the confluence flow for about 10 months of the year. Arthurs Creek carries marginally more water during low flow periods while Diamond Creek is the larger of the two in flood. Tributary creeks are ephemeral, running for about six to eight months of the year, but drying and generally lacking natural pools over late summer/early autumn. The pools in sections of Diamond Creek between Wattle Glen and Hurstbridge are 1.0 to 1.5 m deep. There are few natural meadows remaining on the floodplain. The permanent pond at Ferguson Park is about 0.5 ha, fringed by another 0.5 ha of meadows.

The lower reaches of Scrubby, Watery Gully and Cherry Tree creeks may have been perennial prior to land clearing and damming in the catchment. In wet years they probably maintained a small flow over summer/autumn, fed from seepage and springs. Now, in summer, the creeks contain shallow, static pools, exposed rocky reefs and dry cobble and gravel riffles with sandy banks. The creek channels are deeply scoured and the banks are undercut and have undergone severe slumping and erosion. The water quality is poor due to bare ground runoff and septic tank and domestic water outfall.

Rainfall: 660–740 mm.

Site 70 Cherry Tree Creek

- Map Reference:** 7922 415327 to 7922 428298 (Cherry Tree Creek). One minute lat/long grids include 37° 38' x 145° 12' to 145° 13' and 37° 39' x 145° 13'.
- Location/Size:** The site occurs east of Flat Rock Road and contains the catchments of Cherry Tree Creek between the Kangaroo–St Andrews Road in the east and Church Road in the north. Approximately 350 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage—blocks downstream and upstream of Cochranes Lane along Cherry Tree Creek; NRE. Private: bushblocks, orchards and cattle and horse grazing farmlets.
- Landforms:** Foothill (see NLH C). Elevation is 80–200 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Manna Gum gully woodland (10.1); Messmate gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark valley forest (31.1).

FAUNAL SIGNIFICANCE: Site 70 Cherry Tree Creek

Assessment: Regional—Category 2 (D, E)

Reference grids for the significance keys include:

70^a: 37° 38' x 145° 13'; upper Cherry Tree Creek, Hurstbridge

c. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 70^a: 5 species at Yaralla Road on 6 October 1991

j. Ground mammals

Local. 70^a: 4 species including the Common Wombat and Black Wallaby at Yaralla Road on 6 October 1991

k. Frogs

Local. 70^a: 4 species including the Victorian Smooth Froglet and Bibron's Toadlet at Cochranes Lane on 30 March 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 70^a: 109 species

b. Native birds

Regional. 70^a: 59 species

c. Native mammals

Regional. 70^a: 6 species

d. Herpetofauna

Regional. 70^a: 10 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 70^a: 3 species

d. Regionally rare fauna (R3 species)

Regional. 70^a: 1 species. **Birds:** White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 70^a: 2 species. **Birds:** Rainbow Bee-eater. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 70^a: 2 species. **Birds:** Rose Robin. **Reptiles:** Delicate Skink

Outlook

The faunal significance may decline due to loss of habitat links and an inability of the fauna in the habitat refugia to cope with the rising levels of human impact.

FAUNA

Other Significant Fauna

Birds

Ed **70^a: White-browed Woodswallow.** Four seen in Yellow Box–Candlebark valley forest (31.1) on a conservation covenant block at Yaralla Road on 6 October 1991. They stayed for some time before moving on.

Ee **70^a: Rainbow Bee-eater.** A pair nested in a dry gully in Red Stringybark herb-rich foothill forest (6.1) off Cherry Tree Creek, on Hoebergin Road in summer 1991/92.

Ef **70^a: Rose Robin.** One visited a house garden in Red Box–Red Stringybark box–stringybark woodland (11.1) at the top of Cherry Tree Road on 10 May 1992 (Rosemary Hendry pers. comm.).

Reptiles

Ef **70^a: Delicate Skink.** Two were recorded in Yellow Box–Candlebark valley forest (31.1) at Cochranes Lane on 30 March 1992.

Frogs

Ee **70^a: Bibron's Toadlet.** One located in a nest under a log in Yellow Box–Candlebark valley forest (31.1) at Cochranes Lane on 30 March 1992. The Victorian Smooth Froglet was calling nearby from Messmate–Swamp Gum gully woodland (10.2) in the Water Frontage Reserve along Cherry Tree Creek.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective habitat links are present. There are fragmented links to the Red Shirt Gully Creek, Kangaroo Ground–St Andrews Road Red Ironbarks and Hurstbridge to Kangaroo Ground Red Ironbarks sites.</p>	
<p>Loss of effective links. Threatening arboreal mammals and ground fauna.</p>	<p>Strengthen habitat links. Further habitat fragmentation must be prevented. A plan should be implemented for more effective linkage with the Red Shirt Gully Creek, Kangaroo Ground–St Andrews Road Red Ironbarks and Hurstbridge to Kangaroo Ground Red Ironbarks sites.</p>
Other Issues	
<p>Boneseed, Montpellier Broom and Flax-leaf Broom. These species are proliferating throughout the site, particularly along roadsides.</p>	

Site 71 Haleys Gully/Ironbark Road Red Ironbarks

Map Reference:	7922 383336 (Haleys Gully Ironbarks nectarfauna census plot); 7922 365315 (Ironbark Road Ironbarks nectarfauna census plot). One minute lat/long grids include 37° 37' x 145° 10', 37° 38' x 145° 08'.
Location/Size:	Stands of Red Ironbark occurring between Kendalls Lane and Boyds Road west of Hurstbridge and on Ironbark Road near Broad Gully Road south-east of Yarrambat. Approximately 200 ha.
Municipality:	Shire of Nillumbik and City of Whittlesea.
Land Tenure/Use:	Public: nil, apart from roadsides. Private: Horse grazing farmlets and bushblocks.
Landforms:	Foothill (see NLH C). Elevation is 110–170 m.

Scientific and Educational Values

Scientific reference. The site contains two bird census monitoring points (Haleys Gully Road Ironbarks and Ironbark Road Ironbarks).

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Ironbark–Yellow Gum box–ironbark woodland (12.2)

Rare flora: Emerald Greenhood

Notable features: stands of Red Ironbark

FAUNAL SIGNIFICANCE: Site 71 Haleys Gully/Ironbark Road Red Ironbarks

Assessment: State—Category 3 (B, C); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

71^a: 37° 37' x 145° 10'; Haleys Gully Road, Hurstbridge

71^b: 37° 38' x 145° 08'; Ironbark Road, Yarrambat

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 71^a: Regent Honeyeater

c. Rare fauna

Regional. 71^a: Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

State. 71^a: 9 species in a 2 ha/20 minute nectarfauna count at the Haleys Gully Road Ironbarks census plot on 12 June 1988

i. Arboreal mammals

Regional. 71^a: 4 species including the Brush-tailed Phascogale and Feathertail Glider spotted in the census plot on 28 June 1988

k. Frogs

Regional. 71^a: 6 species including the Bibron's Toadlet and Victorian Smooth Froglet in a 20-minute frog count at Haleys Gully Road on 28 June 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 71^a: 97 species

b. Native birds

Regional. 71^a: 83 species

c. Native mammals

Regional. 71^a: 7 species

d. Herpetofauna

Local. 71^a: 7 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 71^a: 10 species

b. Regionally endangered fauna (R1 species)

Regional. 71^a: 1 species. **Birds:** Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

Regional. 71^a: 4 species. **Birds:** Red-capped Robin, Black-chinned Honeyeater, Fuscous Honeyeater.
Mammals: Brush-tailed Phascogale

Regional. 71^b: 2 species. **Birds:** Black-chinned Honeyeater, Fuscous Honeyeater

d. Regionally rare fauna (R3 species)

Regional. 71^a: 2 species. **Birds:** Spotted Quail-thrush. **Mammals:** Feathertail Glider

e. Regionally depleted fauna (R4 species)

Regional. 71^a: 3 species. **Birds:** Bassian Thrush, Speckled Warbler. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Local. 71^a: 6 species. **Birds:** Brush Bronzewing, Australian Shelduck, Barn Owl, Rose Robin, Red-browed Treecreeper, White-winged Chough

F. POPULATION DENSITY: Viability and Abundance—point census

e. Honeyeaters

Regional. 71^a: 110 in a 2 ha/20-minute count at the Haleys Gully Road Ironbarks census plot on 12 June 1988

l. Regionally vulnerable fauna (R2 species)

Regional. 71^a: 5 Fuscous Honeyeaters in a 2 ha/20-minute nectarfauna count at the Haleys Gully Road Ironbarks census plot on 12 June 1988

Outlook

Continued fragmentation with bushblock subdivision within and surrounding the Red Ironbark stands will likely eliminate the Regent Honeyeater, Black-chinned Honeyeater and Fuscous Honeyeater from the site. The faunal significance will decline from State Category 3 to Regional unless strong conservation and habitat enhancement measures are adopted. Maintaining the current faunal significance depends on enhancing habitat links to redress the declining nectarfauna and vigour of the Red Ironbarks (see Regional Habitat Link Strategy).

FAUNA

Rare or Threatened Fauna

- Ba* **71^a: Regent Honeyeater.** One present at the ironbark census plot on 12 June 1988 in flowering Red Ironbark box–ironbark woodland (12.2) on the north side of Haleys Gully Road, 400 m east of Broad Gully Road.
- Bc* **71^a: Brush-tailed Phascogale.** Red Ironbark box–ironbark woodland (12.2) during spotlighting on the north side of Haleys Gully Road on 28 June 1988. The phascogale was on a trunk of a Red Ironbark.

Other Significant Fauna

Birds

- Ec* **71^a: Red-capped Robin.** One in a lightly timbered area of Red Ironbark box–ironbark woodland (12.2) on the south side of Haleys Gully Road on 12 June 1988.
- Ed* **71^a: Spotted Quail-thrush.** A pair in a saddle of the two hills containing Red Ironbark box–ironbark woodland (12.2) between Haleys Gully Road and Boyd’s Road on 12 June 1988. The area contained Grey Tussock-grass and low shrubs such as Grey Everlasting, Common Heath and Narrow-leaf Bitter-pea. Regenerated thickets of Burgan were present on cleared land flanking the gully.
- Ee* **71^a: Bassian Thrush and Speckled Warbler.** A single Bassian Thrush amongst tall shrubs including Dogwood, Victorian Christmas-bush and Cherry Ballart in the headwaters of a small gully north of Haleys Gully Road in Red Stringybark herb-rich foothill forest (6.1) on 12 June 1988. A party of Speckled Warblers in a lightly timbered area of Red Ironbark box–ironbark woodland (12.2) on the south side of Haleys Gully Road on 18 May 1989.

71^a: Red Ironbark nectarfauna census: Haleys Gully Road Ironbarks. Annual 2 ha/20-minute counts were conducted in Red Ironbark box–ironbark woodland (12.2) between 0940 and 1000 hours during a sunny and calm period each June from 1977 to 1992. The census plot covered a hectare of land on either side of Haleys Gully Road, about 400 m south-east of Broad Gully Road. Haleys Gully Road runs through a saddle separating two hills containing Red Ironbark. The north section of the plot occupied bushland on the eastern slopes of one of the hills and the southern section occupied the northern slopes of the other hill. Red Stringybark herb-rich foothill forest (6.1) occupies the sheltered hill-slopes and Red Box–Red Stringybark box–stringybark woodland (11.1) occurs on surrounding exposed hill-slopes.

Peak flowering years when over 30% of the Red Ironbarks flowered heavily included 1977 (12 June), 1983 (17 June) and 1988 (12 June). These years respectively contained 58, 17 and 15 heavily flowering trees. In all other years, including each of 1989 to 1992, less than 10% of the trees flowered.

Haleys Gully Road Ironbarks: Results

1977 bird summary: 11 species and 620 individuals recorded including the White-naped Honeyeater (300), Black-chinned Honeyeater (14), Brown-headed Honeyeater (200), Eastern Spinebill (4), Regent Honeyeater (3), Yellow-faced Honeyeater (20), White-eared Honeyeater (2), Yellow-tufted Honeyeater (4), Fuscous Honeyeater (30), Crescent Honeyeater (3) and Red Wattlebird (40).

1983 bird summary: 12 species and 298 individuals recorded including the White-naped Honeyeater (130), Black-chinned Honeyeater (8), Brown-headed Honeyeater (60), Eastern Spinebill (4), Yellow-faced Honeyeater (15), White-eared Honeyeater (1), Yellow-tufted Honeyeater (2), Fuscous Honeyeater (5), White-plumed Honeyeater (10), Crescent Honeyeater (1), Noisy Miner (2) and Red Wattlebird (60).

1988 bird summary: 12 species and 110 individuals recorded including the White-naped Honeyeater (15), Black-chinned Honeyeater (2), Brown-headed Honeyeater (9), Eastern Spinebill (2), Regent Honeyeater (1), Yellow-faced Honeyeater (2), Fuscous Honeyeater (5), White-plumed Honeyeater (20), New Holland Honeyeater (2), Noisy Miner (10), Bell Miner (2) and Red Wattlebird (40).

Haleys Gully Road Ironbarks: Discussion

In 1977 the plot supported 96 Red Ironbarks with DBH exceeding 30 cm and was contained in a stand of about 50 ha of Red Ironbark box–ironbark woodland, one of the most extensive in NEM. Clearing by 1988 had reduced the ironbark density on the plot to 46 trees and the stand had become substantially fragmented. The Red Ironbarks in the southern section were cleared in late 1977. The block has been intermittently grazed but has

not been subdivided. Haleys Gully Road was widened and sealed in early 1979 and power lines along the southern verge of the road eliminated a strip of mature ironbarks. These included the central reference tree from which the first two years nectar/blossom production rates had been measured. The northern section underwent 8 ha subdivision in the mid-1980s. A house was erected on the block containing the hill-crest. This block has been subsequently grazed by horses. A track (now badly eroded and the edges severely weed infested) and 20 metre strip to the east was carved through the centre of the census plot into another of the blocks in the northern section. Sections adjoining this track were bulldozed in July 1993.

Tree clearing and stand fragmentation over the 12-year period from 1977 to 1988 caused the nectar secretion and blossom rates of the trees to fall by 50% and the ratio of heavy flowering trees to non-flowering trees to fall by 33%. This in combination with the 50% reduction in the number of mature Red Ironbarks led to a six-fold decline in the density of avian nectivores and a highly significant twenty-fold decline in the density of forest-dependent species. In 1988, 68% of the nectivores present were species that occupy forest-edges (Red Wattlebird, Noisy Miner and White-plumed Honeyeater). These comprised over 90% of the nectivores over the last four consecutive poor flowering years. The Red Wattlebird was relatively less common (6% of the total) and the Noisy Miner and White-plumed Honeyeater were absent in 1977 before the onset of habitat fragmentation. The stand fragmentation resulted from a combination of road widening, encroaching settlement, forest clearing on adjacent farmland and understorey degradation due to livestock grazing.

Nectar production, flowering tree and blossom rates were measured each year (see Regional Habitat Link Strategy). The morning nectar peak of the Red Ironbarks flattened out and the ratio of flowering trees and their blossom rates and length of productive flowering season steadily declined over the 12-year study. The natural flowering cycle of stands of Red Ironbark contains one year in every four to five where more than 50% of the trees flower heavily. This cycle appears to have been disrupted in the Haleys Gully Road Red Ironbarks.

Land clearing led to increased populations of edge-dwelling birds, a decline of insectivorous birds and increased rates of leaf defoliation (see Widespread Threatening processes in Volume 1). A six to eight-fold decline in the density of beneficial foliage insectivores occurred and the rate of leaf damage, branch dieback and foliage loss caused by insects (both Gum-leaf Skeletonisers and psyllids) increased by a proportional amount. Healthy, full-crowned trees with little evidence of dieback in the 1970s now appear stressed and have undergone a decline (e.g. advanced dieback in a canopy composed of sparse clumps of epicormic foliage). This foliage cover is unsuitable for many species of foliage insectivores.

The conclusion can be drawn that there appear to be complex inter-relationships between nectar-trees and their physical environment and nectivorous and insectivorous birds. This serves as a clear warning that fragmentation of Red Ironbark ecosystems by land clearing can result in broad-scale disruptions to the biota.

Nectivore summary for the Haleys Gully Road Ironbarks bird census

Ba/Eb **71^a: Regent Honeyeater.** This species was an annual winter visitor to the ironbark stand during the early and mid-1970s before extensive habitat fragmentation occurred. Three birds were recorded in June 1977 and only one bird has been recorded in the censuses since 1978 (June 1988). Most of the large and vigorous ironbarks important to the honeyeater along the Haleys Gully Road verge were felled in early 1979. Bushblock subdivision that encroached during the 1980s has increased the degree of thinning and fragmentation of the plot and adjacent stands.

Ec **71^a: Black-chinned, Fuscous and Yellow-tufted Honeyeaters.** Each was present in relatively substantial numbers in 1977/78. The Black-chinned and Fuscous had substantially declined and the Yellow-tufted had been eliminated by 1988. See site 40 for further discussion.

Noisy Miner. They established after the 1982 drought and due to their competitive and aggressive nature toward foliage insectivores, have led to dramatic increases in the rate of leaf defoliation and tree decline (dieback) caused by foliage insects (particularly the Gum-leaf Skeletoniser, but also psyllids). A result of the dieback has been reduced flowering and nectar secretion rates. Trees have become isolated along the roadside and in adjacent bushland due to tree clearing from road widening and bushblock farmlet subdivision (see the Regent Honeyeater). This has occurred throughout most stands of Red Ironbark box-ironbark woodland in NEM. The problem is most acute near townships in the Shire of Nillumbik. Similar to the Bell Miner, the Noisy Miner

occupies small habitat patches and strips and the edges of larger woodland stands. They have benefited greatly from tree clearing and stand fragmentation. They co-operatively defend and aggressively drive-out internal forest habitat insectivores and nectivores, particularly Spotted Pardalotes and White-naped Honeyeaters. These forage and breed in larger blocks of bushland.

Bell Miner. Populations from closer to Midhurst extended onto the plot in recent years due to bushland fragmentation and housing encroachment along Haleys Gully Road. Bell Miners have spread into Red Ironbark woodlands throughout NEM. The co-occurrence of Bell and Noisy Miners will hasten the dieback rate of the Red Ironbarks. See the Yarrambat site.

White-naped and Brown-headed Honeyeaters. The White-naped usually out-numbers the Brown-headed by about 2:1. Both declined dramatically over the 12-year study. Their combined populations in 1977 comprised almost 80% of the nectivores present. This fell to 50% in 1983 and 20% in 1988. Between 1989 and 1992 they comprised less than 5% of the total. Both species are also important foliage insectivores.

White-plumed Honeyeater. Absent before fragmentation, they established in the 1980s and are now the dominant small honeyeater. They are a legacy of advancing residential development and forest fragmentation in NEM.

Crescent and White-eared Honeyeaters. These have declined. Clearing and livestock grazing in the bushblocks has removed much of their tall shrub (e.g. Black Wattle, Cherry Ballart and Sweet Bursaria) and low shrub (e.g. Common Heath, Common Correa and Rosemary Grevillea) habitat. Cat predation may be a significant factor.

New Holland Honeyeater. They arrived in recent years as a result of encroaching urban settlement at Midhurst and the development of bushblock gardens.

Summary of beneficial resident foliage insectivores at the Haleys Gully Road census plot: Species include the Striated Thornbill, Buff-rumped Thornbill, Weebill, Spotted Pardalote, Grey Shrike-thrush and Golden Whistler. Each underwent a two to six-fold decrease in abundance over the 12-year study. There were also substantial losses in spring-summer migratory species (e.g. flycatchers, Rufous Whistler, Olive-backed Oriole, White-throated Gerygone, cuckoos and Black-faced Cuckoo-shrike) visiting the plot. The reasons for these declines are the combined effects of stand clearing and thinning, urban encroachment and the establishment of forest edge-inhabiting species.

The honeyeaters and canopy insectivores are important control agents of foliage insects while the presence of the Noisy Miner enhances these species (see above comments). The decline of the honeyeaters illustrates the delicately balanced environmental feedback system operating in Red Ironbark woodland. Fragmentation and thinning of the stand has led to an increase in aggressive forest-edge species and a decline in forest-dependent honeyeaters and canopy insectivores. The honeyeaters and insectivores play a significant role in abating foliage damage. The resultant high rate of defoliation/dieback has reduced the flower/nectar production, spiralling the decline in honeyeater populations.

71^b: Red Ironbark nectarfauna census: Ironbark Road Ironbarks. Annual 2 ha/20-minute counts were conducted in the Red Ironbark box-ironbark woodland to the east of Ironbark Road from Collins Lane to Black Gully Road from 1977 to 1990. In 1977, the plot contained all the species (at similar population densities) recorded at Haleys Gully Road with the exception of the Regent Honeyeater. Ironbark Road was widened and sealed and large ironbarks on the eastern road verge were cleared in 1975/1976. Severe fragmentation of the stand and reduction of populations of forest-dependent honeyeaters resulted from the ensuing subdivision, land clearing and livestock grazing. The plot is now dominated by a large population of Noisy Miners and garden birds such as Red Wattlebirds, White-plumed Honeyeaters and alien species. Since 1983, the only year significant nectarfauna species were present was in 1989 when 21 forest birds including 2 Black-chinned Honeyeaters and 4 Fuscous Honeyeaters were recorded. 550 forest birds had been recorded in 1977. The census study site was scrapped in 1990.

Mammals

Ed **71^a: Feathertail Glider.** One in Red Ironbark box–ironbark woodland (12.2) while spotlighting on the north side of Haleys Gully Road on 28 June 1988. The glider was feeding on nectar from blossoms on a low hanging branch of a Red Ironbark.

Frogs

Ee **71^a: Bibron's Toadlet.** Recorded at the head of a gully under Red Stringybark herb-rich foothill forest (6.1) on the north side of Haleys Gully Road about 400 m east of Broad Gully Road on 20 June 1988 and 18 May 1989.

MANAGEMENT

Threatening Processes

Regional Habitat Link Strategy

Habitat connectivity. There are partially fragmented links south-west to the Plenty River–Diamond Creek Link and east to Wattle Glen to Hurstbridge and Hurstbridge to Arthurs Creek sites. The site contains one of few bushland links between Diamond Creek and the Plenty River.

Red Ironbark woodland fragmentation and dieback due to bushblock settlement. See the Kangaroo Ground–St Andrews Road Ironbarks site. Further bushblock subdivision and fragmentation of ironbark blocks will lead to increased dieback levels and reduced avifauna populations. The declining vigour of the Red Ironbarks will continue the substantial and widespread decline in flora and fauna values of the ironbark woodland ecosystem.

 Conservation Measures

 Regional Habitat Link Strategy

Strengthen habitat links. The site supports faunal movement in the Plenty River–Diamond Creek Link site between Plenty Gorge and the Diamond Creek catchment. Further fragmentation of the link may critically isolate the herb-rich foothill forest/box–ironbark woodland biota in Plenty Gorge. An effective plan should be formulated for the retention of these links.

Red Ironbark Conservation Area. Removing indigenous eucalypts should require a planning permit. Stands of Red Ironbark throughout the Shire of Nillumbik containing significant native ground flora should be protected from livestock grazing. Clearing permits should not be granted where they conflict with the purposes of the Regional Habitat Link Strategy. Further housing within Red Ironbark woodland needs to be restricted. Houses should be located on cleared sections of blocks. No clearing of Red Ironbarks should be permitted unless a proposal is accompanied by a satisfactory Environmental Impact Assessment. Any successful clearing permit should provide for guaranteed protection and management of remaining stands and habitat links. Red Ironbark should be replanted on nearby farmland to buffer the fragmentation effect caused by bushblock development. An area of major concern is the impact on stands of Red Ironbark along Haleys Gully Road of incremental urban development from Hurstbridge.

Regional Red Ironbark/nectarfauna conservation strategy. Areas of natural habitat, particularly amongst Red Ironbarks, supporting recent sightings of Regent Honeyeaters are of critical importance to the species. All stands of Red Ironbark in NEM must be protected and managed for the conservation of honeyeaters. All must be protected from further habitat loss and degradation. Land-use issues in areas of significant or sensitive habitat in need of address include bushblock development and associated habitat loss and degradation such as the spread of weeds and animal pests (including companion animals), domestic timber harvesting and livestock grazing (see the Kangaroo Ground–St Andrews Road Ironbarks site).

Protection of Red Ironbark bushblocks at Midhurst. Until being bulldozed without a permit in 1993, a block on the north side of Haleys Gully Road to the east of Broad Gully Road, contained the endangered Charming Spider-orchid. It also contained a population of the rare Emerald Greenhood and a host of other significant orchids. The adjoining block to the west supported a reference stand of Red Ironbark. It has been grazed by horses and has become weed invaded. Significant blocks in the site need to be identified and protected from further clearing or livestock grazing. Conservation management plans should be formulated for the blocks, particularly the control of weeds and household disturbance. Future subdivision proposals should carefully consider environmental effects. Houses should be sited in areas of least impact to the bushland. Large distances from existing access involving long driveways and service easements should be avoided.

 Other Issues

Require weed control along Haleys Gully, Broad Gully, Ironbark and Black Gully Roads. As development proceeds, the roadside verges may comprise the only significant remaining understorey. The incidence of weeds along the road verges has worsened over the last decade. Infestations of Montpellier Broom and Flax-leaf Broom require immediate control.

Planning Recommendations

Red Ironbark Conservation Area. The most critical requirement is the consolidation of all existing and potential stands of Red Ironbark in the site under conservation management including habitat protection and enhancement works (in accordance with the Regional Habitat Link Strategy). This entails specific protection and management of the Red Ironbarks, their nectarfauna and the orchid flora. Negotiation of conservation covenants or similar conservation agreements as to the management of Red Ironbarks and other significant bushland on private land would be desirable. This should be accompanied by the development of a habitat protection incentive scheme.

Site 72 Hurstbridge to Kangaroo Ground Red Ironbarks

Map Reference:	7922 430280 to 7922 410320 (south point to north point). One minute lat/long grids include 37° 39' x 145° 11', 37° 39' x 145° 12' and 37° 40' x 145° 12'.
Location/Size:	Red Ironbark ridges and intervening valleys west of Flat Rock Road from the Kangaroo Ground–St Andrews Road (south of Dawsons Road) to north of Dewar Drive Hurstbridge. Approximately 370 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: Temple Ridge Reserve (Shire of Nillumbik). Private: bushblocks and cattle and horse grazing farmlets (generally 8 ha).
Landforms:	Foothill (see NLH C). Elevation is 70–200 m.

Scientific and Educational Values

Plant TYPE locality: Charming Spider-orchid. Bailey Gully Road.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Red Ironbark–Yellow Gum box–ironbark woodland (12.2)

Relatively intact and extensive stands: Messmate gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1);

Partially intact or small stands: Messmate herb-rich foothill forest (6.3); Manna Gum gully woodland (10.1); Red Stringybark box–stringybark woodland (11.3); Yellow Box–Candlebark valley forest (31.1)

Endangered flora: Charming Spider-orchid, Crimson Spider-orchid

Vulnerable flora: Wine-lip Spider-orchid, Clover Glycine

Rare flora: Large Rusty-hood, Bearded Greenhood, Slender Tick-trefoil

Critical assemblages or populations: Charming Spider-orchid Critical Conservation Area (largest known population in the world). Rare or threatened plants; high orchid diversity (50 species); high native species and regionally significant species (74) diversity; reference stand of Red Ironbark box–ironbark woodland and disjunct goldfields flora including Large Rusty-hood and Cypress Daisy-bush.

FAUNAL SIGNIFICANCE: Site 72 Hurstbridge to Kangaroo Ground Red Ironbarks

Assessment: Regional—Category 1 (B, C, D, E)

Reference grids for the significance keys include:

72^a: 37° 39' x 145° 11'; Temple Ridge/Bailey Gully Road, Hurstbridge

72^b: 37° 39' x 145° 12'; Heather Avenue/Silvan Road/Moonlight Mine, Wattle Glen

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 72^b: Common Bent-wing Bat at Moonlight Mine; Fiery Jewel butterfly at Silvan Road

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

Regional. 72^b: 8 species in flowering Red Ironbarks at Heather Avenue on 18 May 1989

h. Bats

Regional. 72^b: 6 species trapped at Heather Avenue on 10 March 1989

k. Frogs

Regional. 72^b: 7 species including the Southern Toadlet and Victorian Smooth Froglet at Silvandale, Silvan Road on 10 March 1989

l. Reptiles

Regional. 72^b: 8 species including the Tree Dragon, Delicate Skink, Bougainville's Skink and Lowland Copperhead at Silvandale, Silvan Road on 10 March 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 72^b: 109 species

b. Native birds

Regional. 72^b: 77 species

c. Native mammals

Regional. 72^b: 15 species

d. Herpetofauna

Regional. 72^b: 17 species

f. Butterflies

Regional. 72^a: 30 species (Temple Ridge/Bailey Gully Road)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 72^{ab}: 3 species

b. Regionally endangered fauna (R1 species)

Regional. 72^b: 1 species. **Butterflies.** Fiery Jewel

c. Regionally vulnerable fauna (R2 species)

Regional. 72^b: 2 species. **Birds.** Satin Bowerbird. **Mammals.** Common Bent-wing Bat. **Butterflies.** Bright Copper

Regional. 72^a: 1 species. **Butterflies.** Bright Copper

e. Regionally depleted fauna (R4 species)

Regional. 72^a: 2 species. **Butterflies.** Spotted Brown, Blue Jewel

f. Regionally restricted fauna (R5 species)

Local. 72^b: 5 species. **Birds.** Brush Cuckoo, Red-browed Treecreeper. **Reptiles.** Delicate Skink, Bougainville's Skink. **Frogs.** Southern Toadlet

Local. 72^a: 5 species. **Butterflies.** Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure

Outlook

The faunal significance may decline through loss of habitat links and an inability of the fauna in the habitat refugia to cope with the rising levels of impact from humans.

FAUNA

Rare or Threatened Fauna

- Bc* **72^b: Common Bent-wing Bats in the Moonlight Mine.** Up to 100 were known to roost in the mine in the 1970s (Craig Smith pers. comm.). Two were seen leaving the entrance drive on 4 April 1992. They roost in a lower level of the mine. Several areas of old droppings were located along the entrance drive but the main colony vacated this area due to disturbance from human visitation, including smoke inhalation exercises conducted by SES/CFA.
- Bc* **72^b: Fiery Jewel butterfly.** An adult was observed at Silvan Road in the late 1980s (Tim New pers. comm.). Larvae live in association with a 'coconut' ant (*Papyrius* sp. *nitidus* complex). A colony of the ant was located nearby in tree stumps and at the base of stunted Golden Wattles (food-plant of Fiery Jewel larvae) on an exposed hill-slope among Red Box–Red Stringybark box–stringybark woodland (11.1). This may be the breeding site. The butterfly has been observed elsewhere in GM over the last decade only in the southern Plenty Gorge (see site 42).

Other Significant Fauna

Birds

- Ec* **72^b: Satin Bowerbird.** A male bird was seen in Red Stringybark herb-rich foothill forest (6.1) at Silvan Road in August 1990 (Ian Rasmussen pers. comm.). This species is a very rare winter visitor from the ranges.
- Ef* **72^b: Brush Cuckoo and Red-browed Treecreeper.** Both recorded in Messmate gully woodland (10.2) by Silvan Road, west of Valley Road on 11 March 1989.
- 72^b: Red Ironbark honeyeaters.** Eight species recorded in Red Ironbark box–ironbark woodland (12.2) along Heather Avenue, 300 m south of Dewar Drive on 18 May 1989. Only a few trees were in flower. In a good year it is possible that several rare species might visit the ironbarks including the Black-chinned, Yellow-tufted, Fuscous and possibly, the Regent Honeyeater.

Mammals

72^b: Brown Antechinus and Black Wallaby. A Brown Antechinus was trapped on a sheltered hill-slope under Red Stringybark herb-rich foothill forest (6.1) between Dewar Drive and Heather Avenue in March 1989. This habitat and the exposed hill-slopes under Red Ironbark box–ironbark woodland (12.2) and hill-crests under Red Box–Red Stringybark box–stringybark woodland (11.1) appear suitable for the Brush-tailed Phascogale. Black Wallabies are widespread in the site.

Reptiles

- Ef* **72^b: Delicate Skink and Bougainville's Skink.** Several Delicate Skinks were located on 10 March 1989 in Yellow Box–Candlebark valley forest (31.1) along the roadsides near the junction of Valley Road and Silvan Road. The Bougainville's Skink was recorded under a rock in Red Box–Red Stringybark box–stringybark woodland (11.1) at the top of a nearby ridge on Silvandale.

Frogs

- Ee* **72^b: Southern Toadlet.** Six to eight calling after rain in the valley and adjoining sheltered hill-slopes under semi-cleared Messmate herb-rich foothill forest (6.3) along Silvan Road on 13 February 1988. Toadlets were also recorded in the same area on 10 March 1989. The Southern Toadlet (orange markings on underside) was located under logs at Silvan Road. This species occurs in higher rainfall mountain areas. The valley of Silvan Road between Valley Road and Flat Rock Road would have originally been such an area, with towering Messmate forest and tree-ferns. Most other records of toadlets in the lowland hills are the Bibron's Toadlet (yellow markings on underside), which is a low rainfall plains species. Annual rainfall is 80 mm higher than 2 km away at Hurstbridge, where the Bibron's Toadlet occurs.

Butterflies

Df **72^a: Temple Ridge–Bailey Gully Road.** Thirty species recorded from six visits: 20 October, 25 November and 15 December 1992 and 22 January, 17 March and 5 April 1993.

Locality/landforms include:

- A upper sheltered hill-slopes between Temple Ridge and Bailey Gully Road
- B lower sheltered hill-slopes between Temple Ridge and Bailey Gully Road
- C valley between Temple Ridge and Bailey Gully Road
- D ridge/exposed hill-slopes of Temple Ridge
- E lower exposed valley between Temple Ridge and Bailey Gully Road
- F ridge/exposed hill-slopes of Bailey Gully Road
- G eastern tributaries of the valley between Temple Ridge and Bailey Gully Road and frontage of Silvan Road and Hurstbridge Road

Habitats include:

- Red Stringybark herb-rich foothill forest (6.1/A)
- Messmate herb-rich foothill forest (6.3/B)
- Messmate–Swamp Gum gully woodland (10.2/C)
- Red Box–Red Stringybark box–stringybark woodland (11.1/D)
- Red Stringybark box–stringybark woodland (11.3/E)
- Red Ironbark box–ironbark woodland (12.2/F)
- Yellow Box–Candlebark grassy woodland (31.1/G)

These habitats form the most intact vegetation in the site.

Significant species:

- Donnysa Skipper: adults in flowering Burgan and pupae in Thatch Saw-sedge in December 1992; 10.2/C, 31.1/G
- Spotted Skipper: hill-topping adult on flowering Variable Billy-buttons in November 1992; 12.2/F; presumed breeding on Thatch Saw-sedge
- Bright Shield Skipper: adults feeding in flowering Sweet Bursaria, breeding in Slender Tussock-grass and hill-topping between January and March 1993; 6.1/A, 10.2/C, 11.1/D
- Phigalia Skipper: adults hill-topping/feeding in Common Rice-flower and Variable Billy-buttons in October/November 1992; 11.1/D, 12.2/F
- Phigalioides Skipper: adults in December 1992; 6.1/A
- Symmomus Skipper: adults in March 1993 where breeding on Spiny-headed Mat-rush; 6.1/A, 10.2/C
- Cyril's Brown: hill-topping and feeding in flowering Cypress Daisy-bush in October 1992; 12.2/F
- Spotted Brown: adults in January 1993; 10.2/C
- Bank's Brown: single adult in April 1993; 10.2/C
- Meadow Argus: adults feeding amongst several flowering daisy species at clearing between south end of Lynbrae Avenue and Hurstbridge Road in November/December 1992; 31.1/G
- Dark Purple Azure: adults and pupae at base of Creeping Mistletoe on Red Box in December 1992; 11.1/D
- Bright Copper: adults and small breeding colony on Sweet Bursarias in January 1993; 6.1/A
- Common Imperial Blue: breeding in roadside Black Wattle along Silvan Road; 31.1/G
- Common Dusky Blue: adults on flowering Sweet Bursaria in January 1992, presumed breeding on Downy Dodder-laurel; 31.1/G
- Blue Jewel: adult hill-topping in January 1993 (possibly breeding in Black Wattles); 11.1/D.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Fragmented links to the Wattle Glen to Hurstbridge site, Long Gully Link site and Cherry Tree Creek site.

<p>Housing and Red Ironbark woodland habitat loss, fragmentation and thinning. All stands have become fragmented. This has limited the populations of arboreal mammals and ground fauna.</p>	<p>Strengthen habitat links. Further habitat fragmentation should be prevented. Habitat links need to be re-established, particularly between Red Ironbark stands in this site and those to the east in the Kangaroo Ground–St Andrews Road site.</p> <p>Charming Spider-orchid. The population occurs on private land. About half the population has been secured under wire cages as protection from rabbits. The remaining population requires similar protection. Removal of Large Quaking-grass, Panic Veldt Grass and Boneseed needs to be undertaken. Support is required from granting bodies, governments, councils, property owners and community conservation groups to preserve this species.</p> <p>Flora survey and conservation management plan. This is strongly recommended in recognition of the national botanical significance of the Temple Ridge Reserve/Bailey Gully Road bushland. The area requires formal botanical survey, identification and mapping of rare or threatened plants and plant communities and the formulation of conservation management guidelines.</p> <p>Red Ironbark conservation. All stands of Red Ironbark throughout the Shire of Nillumbik need to be protected from further clearing and grazing. The area of major concern is the current (and potential) impact from houses.</p>
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Other Issues

<p>Environmental weeds. These are proliferating at Temple Ridge and private property east at Bailey Gully Road and along Silvan Road. Problem species include Monterey Pine, Bridal Creeper, Sweet Vernal-grass, Large Quaking-grass, Panic Veldt Grass, Boneseed, Montpellier Broom, Sweet Pittosporum, Spanish Heath, Cootamundra Wattle and Blackberry.</p>	<p>Habitat protection—LandCare Group. The Temple Ridge weed group was active in the late 1980s/early 1990s. If the flora is to be preserved it is essential that a new group be established and expanded into a LandCare Group. The incidence of weeds has worsened over the last five years. The Shire of Nillumbik and other supporting bodies will need to be involved.</p>
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Planning Recommendations

Charming Spider-orchid Critical Conservation Area. If the orchid is to survive it will be necessary to consolidate all existing and potential areas of occurrences in the site under conservation management (see Critical Conservation Areas in Volume 1).

Red Ironbark Conservation Area. Overlays consistent with the purposes of the Regional Habitat Link Strategy should be placed over all stands of Red Ironbark in the site. These should have provisions for habitat protection and enhancement. The overlay would require specific protection and management of the Red Ironbarks, their nectarfauna and the orchid flora. The negotiation of conservation covenants or similar conservation agreements as to the management of significant bushland would be desirable. This should be accompanied by the development of a habitat protection incentive scheme.

Site 73 Plenty River–Diamond Creek Link

Map Reference:	7922 386300 to 7922 363337 (Scrubby Creek); 7922 397315 to 7922 373333 and 387328 (unnamed creek draining the hills south of Bannons Road between Millthorpe Road and Kendalls Lane). One minute lat/long grids include and 37° 38' x 145° 09' to 145° 10' and 37° 39' x 145° 09'.
Location/Size:	The catchment of Diamond Creek between the ridgelines of Bannons Road and Ironbark Road. Approximately 500 ha.
Municipality:	Shire of Diamond Valley.
Land Tenure/Use:	Public: nil, apart from roadsides. Private: 2 ha to 8 ha and residential (Midhurst). Horse grazing farmlets and bushblocks.
Landforms:	Foothill (see NLH C). Elevation is 60–205 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Swamp Gum gully woodland (10.3); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Remnant or degraded stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Red Stringybark box–stringybark woodland (11.3)

Notable features: Strategic Habitat Link.

FAUNAL SIGNIFICANCE: Site 73 Plenty River–Diamond Creek Link

Assessment: Regional—Category 2 (C, D, E)

Reference grids for the significance keys include:

73^a: 37° 38' x 145° 09'; upper Scrubby Creek, Yarrambat

73^b: 37° 38' x 145° 10'; Kendalls Lane valley, Hurstbridge

73^c: 37° 39' x 145° 09'; lower Scrubby Creek, Wattle Glen

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

k. Frogs

Regional. 73^b: 6 species including the Bibron's Toadlet in a 60-minute frog search at Kendalls Lane valley on 21 October 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 73^a: 115 species

b. Native birds

Regional. 73^a: 93 species. **73^b:** 80 species. **73^c:** 51 species

c. Native mammals

Regional. 73^a: 7 species

d. Herpetofauna

Regional. 73^a: 15 species. **73^b:** 11 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 73^{bc}: 4 species **73^a:** 3 species

c. Regionally vulnerable fauna (R2 species)

Regional. 73^c: 1 species. **Birds:** Yellow-tufted Honeyeater

Regional. 73^b: 1 species. **Birds:** White-throated Gerygone

d. Regionally rare fauna (R3 species)

Regional. 73^a: 1 species. **Birds:** Little Corella

Regional. 73^c: 2 species. **Birds:** Collared Sparrowhawk, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 73^b: 3 species. **Birds:** Leaden Flycatcher, Speckled Warbler. **Frogs.** Bibron's Toadlet

Regional. 73^a: 2 species. **Birds:** Leaden Flycatcher. **Frogs.** Bibron's Toadlet

Local. 73^c: 1 species. **Birds:** Leaden Flycatcher

f. Regionally restricted fauna (R5 species)

Regional. 73^a: 12 species. **Birds:** Painted Button-quail, Brush Bronzewing, Royal Spoonbill, Nankeen Night Heron, Little Eagle, Barn Owl, Long-billed Corella, Red-browed Treecreeper, White-winged Chough. **Reptiles.** Delicate Skink, Bougainville's Skink. **Frogs.** Striped Marsh Frog

Local. 73^b: 4 species. **Birds:** Australian Hobby, Long-billed Corella, White-winged Chough. **Reptiles.** Delicate Skink

Local. 73^c: 1 species. **Birds:** White-winged Chough

Outlook

Continued bushblock subdivision, tree clearing and stand fragmentation will likely reduce the faunal significance from Regional to Local unless strong conservation and habitat enhancement measures are adopted. Maintenance of the current faunal significance is dependent on protection and enhancement of habitat links (see Regional Habitat Link Strategy).

FAUNA

Other Significant Fauna

Birds

Ec 73^c: Yellow-tufted Honeyeater. A pair present for several weeks in May 1992 in flowering Swamp Gum gully woodland (10.3) along Scrubby Creek downstream of Broad Gully Road. Fuscous Honeyeaters possibly also visit the flowering Swamp Gums at this time. In the 1970s the Yellow-tufted Honeyeater was an annual late autumn–winter visitor to flowering Red Ironbarks in the district (e.g. Haleys Gully Road and Ironbark Road). It has not been recorded in this habitat since 1983.

73^b: Avifauna of the Kendalls Lane valley. This was the finest area for migratory insectivorous birds in the Shire of Diamond Valley. The area was visited over December 1985/January 1986 at the time of the review by the Shire for a proposed land-fill tip and 80 species of native birds were recorded. Several pair of Leaden Flycatchers and Satin Flycatchers bred in Red Stringybark box–stringybark woodland (11.3; now cleared) on the exposed mid-slopes of the valley. There was a rare observation of interbreeding between the two species. A male Leaden had paired with a female Satin. White-throated Gerygones nested in the canopy of Yellow Box–Candlebark valley forest (31.1; now cleared) flanking the valley while a pair of Australian Goshawks had a stick nest in the canopy of another Red Box on the sheltered side of the valley in Red Stringybark herb-rich foothill forest (6.1; now degraded).

This was one of few valleys in the Shire where gerygones and flycatchers still occurred. A pair of Sacred Kingfishers bred in the large Candlebarks. The Swamp Gum gully woodland (10.3) supported mountain forest species including the Red-browed Treecreeper (now eliminated). This stand supported some of the finest seasonal freshwater meadow observed in NEM. The valley is now extensively cleared and substantially degraded. Forty-nine bird species (largely farmland/fragmentation species) were recorded during a three-hour survey on 21 October 1989. Significant species included the Australian Hobby, Sacred Kingfisher, Leaden Flycatcher and Speckled Warbler. The White-throated Gerygone no longer visits the valley.

73^a: Avifauna of upper Scrubby Creek. Ninety-three native species were recorded downstream of De Fredericks Road from four visits in 1989. Fine stands of Red Stringybark herb-rich foothill forest (6.1) and Red Stringybark box-stringybark woodland (11.3) flanked the valley while Swamp Gum gully woodland (10.3) occurred along the creek. Since that time advancing bushblock subdivision has depreciated faunal values of the area. The area was important for migratory insectivores including the Leaden Flycatcher and Sacred Kingfisher. The flowering Rosemary Grevillea, Common Heath and Common Correa attract the White-eared and Crescent honeyeaters during winter. Red-browed Treecreepers occurred in the Swamp Gum gully woodland (10.3) along the creek. A Painted Button-quail and Brush Bronzewing were seen in winter 1989.

73^c: Avifauna of lower Scrubby Creek. Fifty species of native birds were recorded downstream of Broad Gully Road on 19 November 1991. A pair of White-browed Woodswallows were nesting in a large Swamp Gum. A Collared Sparrowhawk was also seen. Bell Miners, which were localised along the creek in the 1970s, have now established throughout.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. This is the most intact and significant link between the Plenty River and Diamond Creek. The effectiveness and significance of the link is deteriorating due to bushblock housing and poor conservation management.</p>	
<p>Bushblock subdivision of the Kendalls Lane valley. The valley supported a diverse assemblage of birds and orchids. It had been proposed for the Shire of Diamond Valley tip. The Shire scrapped the land-fill tip proposal, partly because of the significant plants and animals. The land was opened up for 8 ha housing subdivision and most of the bushland was bulldozed. The valley became heavily grazed by livestock and has become dominated by Montpellier Broom, Blackberry and other weeds.</p> <p>The valley still supported about 50 native bird species in 1989, but significant bushbirds such as the White-throated Gerygone, Satin Flycatcher, Red-browed Treecreeper and Australian Goshawk have gone and fragmentation species such as the Red Wattlebird, Little Raven and Australian Magpie have taken over.</p>	<p>Strengthen Strategic Habitat Link. The primary function and significance of the site is as a habitat link to adjacent sites of significance. The site is the most important link between the Plenty River and Diamond Creek. Further subdivision and bushland fragmentation would effectively isolate the herb-rich foothill forest and box-stringybark woodland biota of the Plenty Gorge. A plan for retaining and enhancing these links should be formulated. All stands of intact native ground flora and overstorey vegetation in the site need to be protected from further clearing. Clearing permits should not be granted where they conflict with the purposes of the Regional Habitat Link and Hydrological Strategies. An area of major concern is the impact of incremental urban development from Diamond Creek and Hurstbridge.</p>

The most abundant birds now are the alien turtle-dove, starling and Myna, which accompany bushblock subdivision. Of these birds, the aliens were absent and the natives were rare in 1984. The tip would have eliminated the significant flora and fauna in the short-term. Bushblock subdivision in the longer term has achieved a similar result.

Livestock grazing of bushland along upper Scrubby Creek. This area also supported a diverse assemblage of birds and orchids. The blocks have been grazed by livestock and Montpellier Broom, Bulbil *Watsonia*, Three-cornered Garlic and grassy weeds such as Large Quaking-grass and Sweet Vernal-grass have firmly established.

Protection of bushblock grassy woodland from livestock grazing. Only a few relatively intact areas such as De Fredericks Road, Eagland Road and Kendalls Lane valley remain in the site. These should be protected from further grazing. The prior botanical significance of the Kendalls Lane valley would warrant it being rehabilitated through stock exclusion and weed control. The land-owners should be made aware of the biological values of the valley and if receptive should be given assistance with its rehabilitation. Several local properties are Land for Wildlife members. A LandCare group is urgently needed.

Other Issues

Weed control. Infestations of Bulbil *Watsonia*, Three-cornered Garlic, Montpellier Broom, Flax-leaf Broom, Boneseed and Blackberry occur throughout the site. Roadside and streamway infestations in particular, require control.

Site 74 Wattle Glen to Hurstbridge

- Map Reference:** 7922 386294 to 7922 415333 (Diamond Creek); 7922 393296 to 7922 414285 (Watery Gully Creek); 7922 405328 (Fergusons Paddock Wetland); 7922 389323 (hill-slopes and Diamond Creek opposite Hurstbridge Secondary College); 7922 393305 (Wilson Road dam). One minute lat/long grids include 37° 38' x 145° 11' to 145° 12', 37° 39' x 145° 10' to 145° 11' and 37° 40' x 145° 11'.
- Location/Size:** Diamond Creek, lower reaches of tributaries (e.g. Watery Gully and Scrubby creeks) and adjacent catchments from Scrubby Creek Wattle Glen to opposite Bambara Road Hurstbridge. Approximately 220 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage (Watery Gully Creek and small blocks between Silvan Road and Rose Avenue along Diamond Creek; NRE); Municipal parks/recreation reserves—Fergusons Paddock Hurstbridge and Hurstbridge Park, Wilson Road Reserve Wattle Glen (Shire of Nillumbik). Private: Creek flats formerly mixed farming, market gardens and orchards, now commercial/residential areas, farmlets, bushblocks, Fergusons Paddock pony club, schools and town parks.
- Landforms:** Foothill (see NLH C). Elevation is 60–120 m.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point on Diamond Creek at Hurstbridge Park.

HABITAT SIGNIFICANCE:

Assessment: Medium—Category 1

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: Manna Gum (floodplain terrace) riparian forest (5.2); Manna Gum (creek) riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Narrow-leaf Peppermint herb-rich foothill forest (6.2); Messmate–Mountain Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Common Reed–Cumbungi seasonal wetland (25.7); Yellow Box–Candlebark valley forest (31.1)

Remnant or degraded stands: Manna Gum gully woodland (10.1); Swamp Gum gully woodland (10.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Blakely's Red Gum grassy woodland (14.5); Yellow Box–Candlebark grassy woodland (14.6); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5)

Rare species: Variable Nardoo, Yarra Gum

Notable features: Fergusons Paddock wetland complex.

FAUNAL SIGNIFICANCE: Site 74 Wattle Glen to Hurstbridge

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

74^a: 37° 38' x 145° 11'; Diamond Creek, Hurstbridge

74^b: 37° 39' x 145° 10'; Diamond Creek, Wattle Glen

74^c: 37° 40' x 145° 11'; Watery Gully Creek, Wattle Glen

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 74^a: Mountain Galaxias

- C. DIVERSITY: Species/Assemblage Richness—point census/trapping
- b. Waterbirds
Local. 74^a: 12 species including the Cattle Egret, Yellow-billed Spoonbill, White-necked Heron, Australasian Grebe (breeding) and Eurasian Coot at Fergusons Paddock Wetland on 18 August 1990
- f. Breeding migratory insectivores
Regional. 74^a: 10 species including the Sacred Kingfisher, Leaden Flycatcher, Satin Flycatcher, White-throated Gerygone and Rufous Songlark opposite the college oval in December 1990
- g. Breeding parrots
Local. 74^a: 4 species in the Manna Gums and Yellow Box opposite the secondary college oval on 26 December 1990
- h. Bats
Regional. 74^a: 7 species including the Eastern Freetail Bat, Southern Forest Bat and Chocolate Wattled Bat at Hurstbridge Park in December 1992
- i. Arboreal mammals
Regional. 74^a: 4 species including the Sugar Glider and Feathertail Glider in the Manna Gums opposite the college oval on 26 December 1990
- k. Frogs
Local. 74^a: 5 species including the Growling Grass Frog at Fergusons Paddock Wetland on 18 August 1990
- l. Reptiles
Regional. 74^a: 10 species including the Blotched Blue-tongued Lizard, Tree Dragon, White's Skink, Delicate Skink, Bougainville's Skink, Eastern Three-lined Skink, Lowland Copperhead and Eastern Brown Snake opposite the college oval in December 1990
- m. Freshwater fish
Regional. 74^a: 3 species: Short-finned Eel, Mountain Galaxias and Southern Pigmy Perch electrofished at Hurstbridge Park on 14 April 1992
- D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey
- a. All native vertebrate fauna
Regional. 74^a: over 120 species. **74^b:** 112 species
- b. Native birds
Regional. 74^b: 94 species. **74^a:** over 80 species
- c. Native mammals
Regional. 74^a: 18 species. **74^b:** 8 species
- d. Herpetofauna
Regional. 74^a: 20 species. **74^b:** 10 species
- e. Freshwater fish
Regional. 74^a: 3 species
- E. REPRESENTATIVENESS: Significant Species—reference grid survey
- a. GM critical fauna (R1-R4 species)
Local. 74^a: 12 species **74^b:** 9 species
- b. Regionally endangered fauna (R1 species)
Regional. 74^b: 1 species. **Birds:** Dollarbird
- c. Regionally vulnerable fauna (R2 species)

Regional. 74^a: 3 species. **Birds:** White-throated Gerygone, Fuscous Honeyeater. **Mammals:** Eastern Freetail Bat

Regional. 74^b: 1 species. **Frogs:** Peron's Tree Frog

d. Regionally rare fauna (R3 species)

Regional. 74^b: 2 species. **Birds:** Australian Spotted Crake, Little Corella

Regional. 74^a: 1 species. **Mammals:** Feathertail Glider

e. Regionally depleted fauna (R4 species)

Regional. 74^a: 8 species. **Birds:** Latham's Snipe, Leaden Flycatcher, Speckled Warbler, Rufous Songlark. **Reptiles:** White's Skink. **Frogs:** Bibron's Toadlet. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Regional. 74^b: 5 species. **Birds:** Latham's Snipe, Peregrine Falcon, Australian King-Parrot, Leaden Flycatcher, White-winged Triller

Local. 74^c: 1 species. **Birds:** Buff-banded Rail

f. Regionally restricted fauna (R5 species)

Regional. 74^a: 14 species. **Birds:** Brush Bronzewing, Great Egret, Cattle Egret, Nankeen Night Heron, Rainbow Lorikeet, Long-billed Corella, Rainbow Bee-eater, Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** Delicate Skink, Bougainville's Skink

Regional. 74^b: 8 species. **Birds:** Nankeen Night Heron, Australian Shelduck, Barn Owl, Rainbow Lorikeet, Rose Robin, White-winged Chough. **Reptiles:** Common Long-necked Tortoise, Delicate Skink

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory waders

Local. 74^a: 2 Latham's Snipe at Fergusons Paddock Wetland on 20 January 1992

c. Waterfowl

Local. 74^a: 37 birds of 6 species at Fergusons Paddock Wetland in August 1990

g. Rare/restricted colonial fauna

Regional. 74^b: over 100 Australian White Ibis roosting in Manna Gums along Diamond Creek upstream of Wilson Road in winter 1994

Local. 74^a: 10 Cattle Egrets at Fergusons Paddock on 18 August 1990

h. Other fauna

Regional. 74^a: A flock of over 100 Yellow-tailed Black-Cockatoos at Hurstbridge in August 1991

j. Electrofishing rate

Local. 74^a: 17 fish of 3 species (Short-finned Eel, Mountain Galaxias and Southern Pigmy Perch) electrofished at Hurstbridge Park on 14 April 1992

n. Regionally depleted fauna (R4 species)

Regional. 74^a: 9 Mountain Galaxias and 6 Southern Pigmy Perch on 14 April 1992

Outlook

The site contains diversity and rarity amongst all vertebrate fauna groups. It is becoming degraded and many species (e.g. reptiles and freshwater fish) persist in low numbers and are locally threatened. The significance will decline from Regional Category 1 to 2 unless the conservation values are well managed.

FAUNA

Rare or Threatened Fauna

Bc **74^a: Mountain Galaxias in Diamond Creek at Hurstbridge Park.** Nine were electrofished from Diamond Creek at Hurstbridge Park on 14 April 1992. The creek vegetation is Manna Gum riparian forest (5.3). Mountain Galaxias are present throughout upstream sections of Diamond and Arthurs Creek. The altitude at Hurstbridge (70 m) is about the usual downstream occurrence near Melbourne. They were formerly common near the confluence of the creeks at Hurstbridge. The reduction of summer–autumn water flow from upstream farm dams, heavy siltation from land clearing and livestock grazing and polluted runoff have each contributed to their decline. Predation from alien Roach is also a significant factor.

Other Significant Fauna

Birds

Eb **74^b: Dollarbirds along Diamond Creek at Wilson Road.** A pair appeared to be breeding in Manna Gum riparian forest (5.3) upstream of the Wilson Road bridge on 8 December 1991. They were annual spring–summer migrants from northern Australia to the Diamond/Arthurs Creek system during the 1970s. During the 1980s and 1990s they have become very rare and irregular visitors.

Ed **74^b: Australian Spotted Crake and other waterbirds at Wilson Road dam.** The dam on Wilson Road upstream of the Wattle Glen oval supports an extensive stand of Common Reed–Cumbungi seasonal wetland (25.7) and freshwater meadow vegetation on the western arm. An Australian Spotted Crake and a Latham’s Snipe were observed on the western arm on 19 November 1991. Little Pied and Little Black Cormorants are resident in the dead standing trees, indicating a fish supply. Over 100 Australian White Ibis roosted in the trees around the dam and in Manna Gum riparian forest (5.3) along the adjoining section of Diamond Creek in winter 1994. During the day these birds congregated at the Shire of Nillumbik tip at Pretty Hill.

Ee **74^c: Buff-banded Rail.** One in grassy meadows in remnant Manna Gum gully woodland (10.1) along Watery Gully Creek behind the Wattle Glen tennis courts on 21 September 1986 (Joy Pagon pers. comm.).

Ee **74^{ab}: Latham’s Snipe at Fergusons Paddock Wetland and Wilson Road dam.** A few birds roost at Fergusons Paddock Wetland amongst dense grass and reed cover in Common Reed–Cumbungi seasonal wetland (25.7) along the arms and on the islands during spring–summer. Two late season birds were seen on 20 January 1992. At night they possibly venture onto the surrounding lawns and rank grassland to feed. One bird was observed at Wilson Road dam on 19 November 1991.

Ef **74^a: Cattle Egret.** They have visited the lawns and playing fields between Fergusons Paddock and Hurstbridge Park since 1990. They expanded in range into northern Australia from the old world tropics about 60 years ago and were first seen in Victoria in 1949 (Blakers *et al.* 1984, Emison *et al.* 1987). This colonial species is an annual autumn–spring migrant from the Murray Valley of Victoria and the New South Wales Riverina. They are present in NEM from April to November. First appearing on the Plenty Upland Alluvial Plains some 15 years ago, populations have steadily increased in number and range.

74^a: Waterbirds at Fergusons Paddock Wetland. Fourteen species have been recorded at Fergusons Paddock Wetland, the most important being Latham’s Snipe. A few species (e.g. Purple Swamphen, Dusky Moorhen and Australasian Grebe) breed on the wetland. A Great Egret was seen in the shallows on 18 December 1990. With further planting and wetland development, especially closing off some sections to the public during spring, additional waterbirds would be encouraged. Small marshland passerines (e.g. Little Grassbird, Golden-headed Cisticola and Clamorous Reed-Warbler) are also present.

74^a: Bushland birds of the creek and valley forest slopes opposite Hurstbridge Secondary College. The creek and hill-slopes opposite the Hurstbridge Campus ovals of the Diamond Valley Secondary College provide the most intact bushland in the site. Vegetation consists of Manna Gum (floodplain terrace) riparian forest (5.2; degraded), Manna Gum (creek) riparian forest (5.3), Narrow-leaf Peppermint herb-rich foothill forest (6.2; degraded), Swamp Gum gully woodland (10.3; degraded), Red Box–Red Stringybark box–

stringybark woodland (11.1) and Yellow Box–Candlebark valley forest (31.1). The area was visited from 26–28 December 1990 and on 28 August 1991. All records are from December 1990 unless otherwise indicated.

A broad spectrum of forest and woodland birds were recorded. Significant species include the Brush Bronzewing, Brush Cuckoo, Red-browed Treecreeper, White-throated Gerygone, Speckled Warbler, Leaden Flycatcher, Fuscous Honeyeater (one bird in August 1991) and Rufous Songlark. In August 1991 the Gang-gang Cockatoo, Yellow-tailed Black-Cockatoo, Long-billed Corella and Pied Currawong were recorded. Substantial numbers of black-cockatoos and currawongs visit from the ranges during autumn–winter. Gang-gang Cockatoos feed in small family groups on the fruit of Hawthorns and the Yellow-tailed Black-Cockatoos take witchetty grubs from old Silver Wattles. Flocks of up to 100 black-cockatoos have been seen taking ripening seed from township Monterey Pines.

74^b: Birdlist for the Diamond Creek valley at Wattle Glen. A list of 85 native species recorded in 1994 was provided by Damien Cook. Most of the species were recorded in the vicinity of Wilson Road. Habitat present (refer preceding paragraph) include 5.2, 5.3, 10.3, 11.1 and 14.6. Red Stringybark herb-rich foothill forest (6.1) and Common Reed–Cumbungi seasonal wetland (25.7; Wilson Road dam) are also present. Significant species include the Nankeen Night Heron, Australian Shelduck, Peregrine Falcon, Barn Owl, Rainbow Lorikeet, Little Corella, Australian King-Parrot, Rose Robin, Leaden Flycatcher and White-winged Chough.

Mammals

Ec **74^a: Eastern Freetail Bat.** Seven species of bats were trapped near the creek behind the college in December 1990 including a male Eastern Freetail Bat. This species is a rare associate of grassy woodland and riparian forest. It also occurs in riverine forests in the Goulburn and Murray River valleys of northern Victoria. The southern and northern Victorian distributions of this species connect through the Kilmore Gap in the Great Dividing Range. Only one record (Donald Thomson collection from 1930 at the mouth of Diamond Creek, Eltham South), existed for this species in GM prior to the study. It has now been trapped at over a dozen localities in GM, each near water along streams and at swamps, amongst River Red Gums or Manna Gums.

Ed **74^a: Feathertail Glider.** One downstream of the Arthurs Creek Road bridge amongst Silver Wattles while spotlighting along Diamond Creek (Manna Gum riparian forest; 5.3) on 27 December 1990. A Sugar Glider was also recorded.

Ef **74^a: Koala along Diamond Creek—corridor to the Kinglake Ranges.** One in Manna Gum riparian forest (5.3) along the creek in December 1991. They were formerly widespread in the foothill and riparian forests of NEM but were eliminated within decades of settlement (Wheelwright 1862). Animals were released some years ago at Kinglake and Warrandyte and have bred successfully. Sightings in the Hurstbridge–St Andrews district have increased since the mid-1980s. Habitat links between these areas and Kinglake and Warrandyte persist and with replanting could be enhanced.

Similar to the Common Wombat, road mortalities of Koalas are high in settled areas as individuals disperse widely. Without the provision of a contiguous parkland corridor along the creek (see Diamond Creek site), increased development in downstream sections of Diamond Creek will reduce the effectiveness of habitat links between Hurstbridge and Eltham. This will bottleneck the Koala population on the Yarra River at Warrandyte. While suitable and contiguous creek corridor habitat remains, individuals are able to disperse from the Kinglake National Park to the middle section of Diamond Creek. Instances of Koalas being mauled by roaming dogs have been reported in recent years.

Reptiles and frogs

Ef **74^b: Common Long-necked Tortoise.** Several basking on stumps and logs amongst the flooded trees in the western arm of Wilson Road dam on 19 November 1991.

74^a: Valley forest reptiles and frogs. Ten reptile species including the Blotched Blue-tongued Lizard, Tree Dragon, White's Skink, Delicate Skink, Bougainville's Skink, Weasel Skink, Eastern Three-lined Skink, Lowland Copperhead and Eastern Brown Snake were recorded opposite the secondary college oval and in an area toward Wadson Road to the south between 26 and 28 December 1990. The Kangaroo Grass in association

with Yellow Box–Candlebark valley forest (31.1) is important for reptiles. The stand on the west side of the creek opposite the college oval is the most intact remaining in the site. Bibron's Toadlet was recorded on 28 August 1991.

Freshwater fish

74^a: Elimination of the Freshwater Blackfish. The Freshwater Blackfish appears to have been eliminated from Diamond Creek at Hurstbridge in the last 15 years. They are still occasionally recorded upstream in Arthurs Creek at Midhurst (site 66) and in Diamond Creek at Cottles Bridge (site 75). The disappearance is concurrent with an escalation in the rate of urban development radiating from Hurstbridge, which along with bushblock development in the catchment has contributed to a decline in water quality (increased pollution and turbidity) in the stream. Large numbers of Roach also appeared in the stream at this time. This is a scavenging species with broad habitat and environmental tolerances. It is known to prey on blackfish eggs which are deposited on or within submerged logs. Redfin were present in the 1970s. They are a scavenging species similar to the Roach, but the latter appears better adapted to the turbid and polluted conditions of the shallow creeks.

Ee **74^a: Southern Pigmy Perch.** Six electrofished from Diamond Creek at Hurstbridge Park (now the only locality where pigmy perch have been recently recorded in the creek.) on 14 April 1992. They were formerly widespread and common in the mid-reaches. They are present upstream in Arthurs Creek. Their elimination from most of Diamond Creek is a result of severe loss and degradation of the native instream and riparian habitat, which provide food and cover, and snags, which slow the flow rate, necessary for spawning.

74^a: Electrofishing Survey: Diamond Creek at Hurstbridge Park

Map reference. 7922 402326. **Altitude.** 70 m. **Survey date.** 14 April 1992

Vegetation. Instream: submerged and emergent herbfield. **Bank:** Manna Gum riparian forest: (5.3; poor condition and weed dominated; see threatening processes). **Frontage.** Manna Gum (floodplain terrace) riparian forest (5.2; poor condition); Yellow Box–Candlebark valley forest (31.1; fair condition)

Physical Features:

Pools

Substrate. Deep silt, logs, branches, leaves and willow roots on sheet siltstone; log and urban flotsam jams at downstream end of pools; channel scoured

Maximum size (mid-autumn). 1.5 m wide by 1.5 m deep by 40 m long

Riffles

Substrate. Gravel and cobble on sheet siltstone

Flow (mid-autumn minimum): Size. 1.0 m wide by 5 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 2.4 ML/day

Flow (mid-winter normal): Size. 6.0 m wide by 40 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 228 ML/day

Water quality

Autumn: Temperature. 14.4°C. **Conductivity.** 330 ms. **Salinity.** 0 ppt. **Turbidity.** High

Winter: Temperature. 10.8°C. **Conductivity.** 190 ms. **pH.** 7.23. **Dissolved Oxygen.** 9.8–10.0 ppm. **Turbidity.** High

Fish Recorded During Survey

Native species numbers/status. Short-finned Eel (2); migratory sub-adult. Mountain Galaxias (9); likely breeding resident. Southern Pigmy Perch (6); likely breeding resident

Alien species numbers/status. Roach (100+); likely breeding resident. Goldfish (1); likely breeding resident

Other comments. Freshwater Blackfish were present in the 1970s. The only location recorded for the Southern Pigmy Perch in Diamond Creek and the lowest elevation recorded for the Mountain Galaxias in the Diamond Creek/Arthurs Creek system. Land tenure: council reserve and residential blocks abutting the creek. Bushland below houses on the western escarpment is degraded but not subdivided. Bushland downstream opposite the college oval is moderately intact.

Management

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. There are partially intact riparian links upstream to the Cottles Bridge–St Andrews site and downstream to the Diamond Creek site, and partially intact overland link west to the Haleys Gully/Ironbark Road Red Ironbarks site and Plenty River–Diamond Creek Link site. Overland link partially blocked by houses east to the Hurstbridge to Kangaroo Ground Red Ironbarks site.</p>	
<p>Loss of habitat links and habitat fragmentation. Bushland fragmentation through urban encroachment is a major issue. Links for ground and arboreal marsupials have been severed and many species (e.g. Black Wallabies) have been restricted to pockets in secluded areas.</p> <p>Increasing Bell and Noisy Miners; psyllid infestations and dieback. Defoliation of Blakely's Red Gums between Diamond Creek and Hurstbridge by psyllids and Gum-leaf Skeletonisers appears to be getting worse each autumn. Trees have died in recent years. The stands are highly fragmented and support substantial populations of Noisy Miners and few beneficial insectivorous birds (see Volume 1). Dieback of Swamp Gums has been hastened by Bell Miners, which have also increased as a result of habitat fragmentation. Dieback of several Manna Gums along the creek due to defoliation from insects was noticeable in 1992.</p> <p>Abundance of Black Rats and road-killed native ground fauna. Roads are habitat link barriers for ground fauna. Road-kill is a major mortality factor for the Black Wallaby, Eastern Grey Kangaroo, Common Wombat, snakes and blue-tongued lizards. No native rat or small ground marsupial species was trapped in the site. Black Rats are abundant.</p>	<p>Strengthen habitat links. The highest priority is the re-establishment of an effective habitat link along the creek (Cottles Bridge to St Andrews site upstream and Diamond Creek site downstream). The habitat link strategy requires at least one functional link to each of the surrounding sites that comprise the catchment management units of the mid-section of the creek. This should be built into the strategy as development radiates from Hurstbridge/Wattle Glen.</p> <p>Streamway livestock exclusion zone. Broader fenced strips are required along the creek to reduce the population build-up of Bell and Noisy Miners. This will facilitate plant regeneration and may prevent severe leaf defoliation and dieback of eucalypts and Silver Wattles.</p>
Regional Hydrological Strategy	

Creebank degradation—weeds and erosion. Conservation management of the creek is severely lacking. Sections are degraded and weed infested (e.g. willows—weeping and white crack—Hawthorn, blackberry, Blue Periwinkle, Bulbil *Watsonia*, Three-cornered Garlic, Wandering Jew, English Ivy, Japanese Honeysuckle and alien perennial grasses including Panic Veldt Grass, Cocksfoot and Toowoomba Canary-grass). English Ivy is ringbarking many Manna Gums along the creek. The section immediately upstream of the Arthurs Creek Road bridge is weed infested (e.g. Blue Periwinkle) and is a dismal environmental statement at the gateway to Hurstbridge. Rubbish has been pushed into several sections (e.g. north of Wilsons Road) by earthmoving equipment and severe slumping caused by overgrazing of stream banks has occurred in others. The creek channel is heavily scoured in sections below the Arthurs Creek Road bridge.

Electrofishing site at Hurstbridge Park—declining water quality—polluted stormwater runoff. Pollution and nutrient enrichment has led to eutrophication of pools as they stagnate over summer. The site has a low dissolved oxygen rate. Dissolved oxygen is critical for maintaining instream ecosystems, particularly aerobic bacteria which are vital for the breakdown of pollutants. Insufficient levels lead to anaerobic decomposition of organic material, the production of noxious gases such as hydrogen sulphide and methane and the chemical reduction of iron and manganese

Heavy silt loads are dumped into the creek from earthworks and slumped banks. Without particular care, spraying Blackberry and removing willows will lead to increased bank slumping. Other threats are a high turbidity/siltation rate; severely depleted summer–autumn flow rate; proximity of township area; inadequate native riparian and instream cover; severe bank erosion—slumping and gullyng and tree and bank undercutting; advancing weeds and alien fish; and urban rubbish. The Southern Pigmy Perch and Mountain Galaxias are locally threatened.

The downstream section needs extensive weed removal work. The grassy woodland on the hill-slopes opposite the secondary college oval must be retained for conservation purposes. Residential development of this section will eliminate most of the remaining flora and fauna values of the site. This section requires extensive work including removal of Boneseed, Montpellier Broom and other weeds.

Require council input into streamway restoration plan and wider involvement of community conservation activities. The habitat link utility and condition of the stream banks and riparian and instream vegetation of this section are ‘weak links’ in the Diamond Creek system. A conservation management plan should be devised and implemented for this section of the creek. Resources from council and other management bodies (e.g. Melbourne Parks & Waterways) should be provided to improve the habitat quality of the creek. Management resources should be put into land protection works such as weed control and revegetation programs.

Community creek clean-ups have enabled an improvement in the creek environment. Indigenous plantings near the primary school have attracted new species of birds to the area and is a step toward long-term habitat improvement for the Koala. It has been turned around from an area of neglect to an area rich in wildlife, which is a pleasure to visit. The revegetation area needs to extend downstream to the Arthurs Creek Road bridge. A Friends of Diamond Creek group is urgently required. Focus needs to be placed on the section upstream and downstream of the bridge. The upstream section on the pony club land requires a fence for at least 20 m beyond that present, and extensive planting to broaden the riparian corridor. Willow control and tree and understorey shrub and herb planting is required to stabilise eroded sections. Planting of native shrubs (e.g. Hazel Pomaderris and Victorian Christmas-bush) will attract foliage birds. Control of blackberries and other riparian weeds and follow-up planting of knock-down areas should be undertaken.

Lack of stream summer flow due to farm dam constructions. Dams in the catchments have greatly reduced the rate of summer flow in the creek. This and declining water quality have led to the local elimination of the Freshwater Blackfish and breeding populations of Platypus.

Damming and livestock grazing and trampling of floodplain meadows. There are few natural freshwater meadows remaining along the creek floodplain. Dams have been sunk in most and the remainder are grazed and trampled by livestock.

This strategy recommends restrictions on the proliferation of farm dams in the catchment. A set of guidelines should be formulated for the development of an effective hydrological cycle with regard to habitat requirements of the creek biota.

Monitoring and improving water quality of creek. The rate of bank erosion and water pollution and turbidity should be monitored. The water quality of Diamond Creek between Eltham and Cottles Bridge may be well under accepted health standards. The low summer flow and high eutrophication rates are major concerns. Total loss or substantial depletion of many aquatic dependent faunal species has occurred over the last two decades (e.g. Platypus).

Other Issues

Vermin populations—foxes, rabbits and alien birds. Foxes are numerous amongst the Blackberry and eroded creek banks and rabbits are common on the exposed escarpments. The dominant ground birds in built-up areas are alien species or aggressive native open space species.

Planning Recommendations

Fergusons Paddock Wetland development and public interpretation facilities. Funding should be sought for further wetland development and creek rehabilitation of Fergusons Paddock. Waterbird usage (e.g. Latham's Snipe) of the wetlands would increase with careful management including sanctuaries (from humans and dogs) and provision of habitat. The public should be encouraged to keep dogs on the leash in the area as they inevitably chase/swim after the birds. With the establishment of viewing hides of waterbirds and nature trails, Fergusons Paddock would provide an environmental focus for Hurstbridge.

NLH D DIAMOND CREEK HURSTBRIDGE TO ST ANDREWS

This management unit consists of two sites of state faunal significance (sites 75 and 76) and surrounding land that forms habitat links.

Map Reference: 7922 412332 to 7922 474368 (Diamond Creek from Bambara Road Hurstbridge to School Road St Andrews).

Location/Size: The unit runs north-easterly from Hurstbridge to St Andrews along Diamond Creek and contains the catchments of several tributaries rising from the Hildebrand Road ridge in the west and the Kangaroo Ground–St Andrews Road ridge in the east. Approximately 1200 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. Diamond Creek forms a narrower valley and floodplain than Arthurs Creek and the hills rise more steeply into the local watersheds and foothills of the Great Dividing Range to the north. Downstream of St Andrews, the creek runs south-westerly between two immediate lines of hills and the watershed ridgelines of Hildebrand Road in the west and the Kangaroo Ground–St Andrews Road in the east. The Diamond Creek valley broadens near the junction of Red Shirt Gully Creek at Cottles Bridge. Diamond Creek is centrally placed between the Templestowe anticline to the west and the St Andrews anticline to the east. The St Andrews anticline lies along the ridgeline of the Kangaroo Ground–St Andrews Road. The anticlines are associated with the Silurian siltstone/mudstone rock type.

Landforms

Foothill: ridges (along the western and eastern perimeter), hill-crests, hill-slopes, gullies, valleys, creeks, stream/floodplain and dams. Elevation is 70–240 m.

Hydrology

Diamond Creek is a perennial third order stream. Flow is very reduced from late summer to mid-autumn and tributaries are ephemeral. The creek contains cobble and gravel riffles and sand bars. Undercut banks surround open water pools (< 1.5 m deep) with submerged logs and emergent snags. The creek channel is scoured and the banks have undergone some slumping and erosion as a result of catchment land clearing and logging and mining episodes. The conditions are less pronounced than in downstream sections and Arthurs Creek. There is a thick layer of silt on the bottom of pools. The proliferation of farm dams in the catchment and resultant low summer flow is an inhibitor on the instream ecosystem. Diamond Creek has no instream dams.

Rainfall: 660–700 mm.

Site 75 Cottles Bridge to St Andrews

Map Reference:	7922 427344 to 7922 474368 (Diamond Creek); 7922 452363 (Watts Lane grassy/gully woodland census plot). One minute lat/long grids include 37° 36' x 145° 13' to 145° 15' and 37° 37' x 145° 13'.
Location/Size:	Diamond Creek from the Cottles Bridge–Strathewen Road at Cottles Bridge to School Road at St Andrews and the hills and gullies to the west of the creek at Watts Lane and between Youngs Road and School Road. Approximately 300 ha.
Municipality:	Shire of Nillumbik.
Land Tenure/Use:	Public: Water Frontage (Diamond Creek); Streamside Reserve (south of School Road and west of Diamond Creek; NRE). Private: farmland (orchards, vineyards and livestock) and bushblocks.
Landforms:	Foothill (see NLH D). Elevation is 90–190 m.

Natural Heritage Values

Landscape. Sections of Diamond Creek (e.g. downstream of Watts Lane) form some of the most intact lowland streamway landforms in GM.

Scientific and Educational Values

Scientific reference. Grassy/gully woodland census plot along Brewers Track, off Watts Lane at Cottles Bridge. Electrofishing site and instream reference point on Diamond Creek at Watts Lane.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Manna Gum (creek) riparian forest (5.3); Narrow-leaf Peppermint herb-rich foothill forest (6.2)

Relatively intact and extensive stands: Manna Gum (floodplain terrace) riparian forest (5.2); Red Stringybark herb-rich foothill forest (6.1); Messmate–Mountain Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Red Stringybark box–stringybark woodland (11.3); Yellow Box–Candlebark grassy woodland (14.6); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5)

Rare species: Yarra Gum

Critical Assemblages or Populations: Strategic Habitat Link. Regent Honeyeater Manna Gum feed-trees.

FAUNAL SIGNIFICANCE: Site 75 Cottles Bridge to St Andrews

Assessment: State—Category 2 (B, C, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

75^a: 37° 36' x 145° 14'; Diamond Creek at Watts Lane, Cottles Bridge

75^b: 37° 36' x 145° 15'; Diamond Creek at St Andrews

75^c: 37° 37' x 145° 13'; Diamond Creek at Cottles Bridge–Strathewen Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 75^a: Regent Honeyeater (February and March 1988)

c. Rare fauna

State. 75^a: Powerful Owl, Masked Owl, Mountain Galaxias, Freshwater Blackfish, Yellow-spot Jewel butterfly

Regional. 75^b: Mountain Galaxias, Freshwater Blackfish, Yellow-spot Jewel butterfly

Regional. 75^c: Little Bittern, Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

Regional. 75^a: 6 species including the Regent Honeyeater in flowering Manna Gums downstream of Watts Lane on 12 March 1988

f. Breeding migratory insectivores

State. 75^a: 12 species on the census plot in October 1990. Highest diversity of the 16 plots in NEM

h. Bats

Regional. 75^a: 6 species including the Gould's Long-eared Bat trapped from 12 to 15 March 1988 downstream of Watts Lane

i. Arboreal mammals

Regional. 75^a: 4 species including the Sugar Glider and Feathertail Glider spotlight on the census plot on 30 October 1989

j. Ground mammals

Regional. 75^a: 7 species including the Long-nosed Bandicoot and Water Rat from 12 to 15 March 1988 at Watts Lane

k. Frogs

Regional. 75^a: 8 species including the Victorian Smooth Froglet and Southern Toadlet on 30 October 1990 on the census plot

l. Reptiles

Regional. 75^a: 7 species including the Tree Dragon, McCoy's Skink, Delicate Skink and Southern Water Skink at Watts Lane on 28 October 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 75^a: over 120 species

b. Native birds

Regional. 75^a: over 80 species

c. Native mammals

Regional. 75^a: 21 species

d. Herpetofauna

Regional. 75^a: 18 species

e. Freshwater fish

Regional. 75^a: 3 species (Freshwater Blackfish, Short-finned Eel and Mountain Galaxias)

f. Butterflies

Regional. 75^a: 31 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 75^a: 25 species

b. Regionally endangered fauna (R1 species)

Regional. 75^a: 3 species. **Birds:** Masked Owl, Regent Honeyeater, Little Friarbird

Regional. 75^c: 1 species. **Birds:** White-bellied Cuckoo-shrike

c. Regionally vulnerable fauna (R2 species)

Regional. 75^a: 5 species. **Birds:** White-throated Nightjar, White-throated Gerygone. **Mammals:** Long-nosed Bandicoot. **Fish:** Freshwater Blackfish. **Butterflies:** Bright Copper

Regional. 75^c: 2 species. **Birds:** Little Bittern. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 75^a: 5 species. **Birds:** Fork-tailed Swift, Pink Robin. **Mammals:** Feathertail Glider, Gould's Long-eared Bat. **Butterflies:** Yellow-spot Jewel

Regional. 75^c: 2 species. **Birds:** Australian Spotted Crake, White-browed Woodswallow

Regional. 75^b: 1 species. **Butterflies:** Yellow-spot Jewel

e. Regionally depleted fauna (R4 species)

State. 75^a: 12 species. **Birds:** Brown Quail, Buff-banded Rail, Powerful Owl, Leaden Flycatcher, Bassian Thrush, Eastern Whipbird, Rufous Songlark. **Mammals:** Platypus. **Reptiles:** Red-bellied Black Snake. **Fish:** Mountain Galaxias. **Butterflies:** Flame Skipper, Spotted Brown

Local. 75^b: 1 species. **Reptiles:** Red-bellied Black Snake

Local. 75^c: 1 species. **Birds:** Buff-banded Rail

f. Regionally restricted fauna (R5 species)

Regional. 75^a: 17 species. **Birds:** Brush Bronzewing, Brush Cuckoo, Rose Robin Olive Whistler, Red-browed Treecreeper, White-winged Cough. **Mammals:** Koala, Water Rat. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Meadow Argus, Dark Purple Azure

Local. 75^b: 2 species. **Birds:** Red-browed Treecreeper. **Reptiles:** McCoy's Skink

g. Nesting birds of prey/parrots

Regional. 75^a: Masked Owl (Messmate hollow in a gully in spring 1994)

F. POPULATION DENSITY: Viability and Abundance—point census

i. Bat trapping rate

State. 75^a: A single trap capture of 61 bats of five species downstream of Watts Lane on 13 March 1988

l. Regionally vulnerable fauna (R2 species)

Regional. 75^a: White-throated Gerygone (3 nesting pairs on census plot in October 1990)

m. Regionally rare fauna (R3 species)

Regional. 75^c: White-browed Woodswallow (3 nesting pairs at Cottles Bridge–Strathewen Road in November 1991)

Outlook

Unless concerted conservation management is undertaken, the faunal significance will decline due to land fragmentation and human disturbance associated with bushblock subdivision.

FAUNA

Rare or Threatened Fauna

Ba 75^b: Regent Honeyeater. The Yarrambat ironbarks and the Manna Gums along Diamond Creek between Cottles Bridge and St Andrews and along the Yarra between Eltham South and Christmas Hills are the most important areas for the species in GM. Sightings were made at Watts Lane in 1988 (one bird on 22 February and two on 12 March). The Manna Gums along the creek had flowered heavily and the Regent Honeyeaters were present for almost a month.

This heavy flowering episode occurs in cycles of five to seven years. In the 1970s the cycles were two to three years and flocks of six or more Regent Honeyeaters were frequently observed. The species was more or

less resident from 1977 to 1981 and was recorded breeding on two occasions. They have declined alarmingly throughout their range. The Cottles Bridge to St Andrews site is the central link along a series of critical but tenuous habitat links to other feeding grounds—through streamway links along the Plenty River and Yarra River and overland habitat links containing Red Ironbark between Smiths Gully and Hurstbridge.

Bc **75^c: Little Bittern.** One on an evening in November 1989, darting across the Heidelberg–Kinglake Road near Red Shirt Gully Road (Ken Rogers pers. comm.). This cover-dependent wetland species is rare in NEM. They are more typical of the grassy wetlands and streams of the volcanic plains.

Bc **75^a: Powerful Owl and diverse arboreal mammal prey populations.** A bird with intermediate plumage, suggestive of a yearling, seen while spotlighting in Messmate gully woodland (10.2) on 30 October 1989. Breeding birds are known from less than 5 km away at Smiths Gully and further afield at One Tree Hill and the upper Diamond and Arthurs creeks. Young of the previous year disperse to the far corners of the adult territories by the time of the next breeding season. The area had attracted the Powerful Owl and a pair of breeding Southern Boobooks as it contained diverse arboreal mammal populations. Thirty minutes spotlighting revealed six Common Ringtails, one Common Brushtail, two Sugar Gliders and one Feathertail Glider.

Bc **75^a: Masked Owl.** A pair bred in Messmate gully woodland (10.2) at the head of a narrow sheltered gully above Diamond Creek midway between Cottles Bridge and St Andrews in winter–spring 1994. This species is the largest member of the Barn Owl family in Australia. They are rarely observed in GM but appear resident in this district. Birds have been recorded nearby at Dunmoochin (site 68) on several occasions. Surrounding bushland habitats at the nest site included 5.3, 6.2, 10.2, 11.1, 11.2 and 31.1 (see Butterflies, *Df*). The floodplain is partially cleared, with an extensive cleared area to the south. The hills to the west toward Hildebrand Road are also cleared. The site provides secluded breeding habitat containing native prey and open country where rabbits are abundant.

The Masked Owl was first observed in late June 1994, when the rasping call of an adult was heard. A pair of adult birds were located. The series of twitters and screeches they uttered suggested they were in courtship. Over the following weeks it was discovered that they were about to breed in a deep, vertical hollow of a Messmate. Eggs (usually two to three) were laid in July, incubated by the female. The male was seen during the day roosting nearby in the dense canopy on the sheltered escarpment (Narrow-leaf Peppermint herb-rich foothill forest; 6.2). Two young were born in late August and reared in spring during a period when rabbits were locally plentiful. The young left the nest in November.

There is evidence that Masked Owls are locally nomadic in these districts. There is also evidence that they remain over an unfixed larger area (e.g. observed over several years at Dunmoochin (site 68). When conditions become favourable they breed. At these times they are sedentary and defend a discrete territory, possibly in a different tree and section from year to year. Myxomatosis went through the local rabbit population in 1991 and the owls were not recorded in the district in 1992, but were observed again in 1993/94 and 1996. Similar to the Barn Owl, successive young may be reared in productive seasons. It will be interesting to monitor the effect of rabbit calicivirus disease (RCD) on the Masked Owl. In the foothills, at least, it is expected that native prey, including the Bush Rat and Long-nosed Bandicoot, will increase once freed from competition with rabbits. . These, along with possums and birds, will provide alternative prey for the owl. Populations of Masked Owls on the plains, which are heavily dependent on rabbits, will fare less well.

Rabbits formed the bulk of the Masked Owl diet at Cottles Bridge. Analysis of regurgitated pellets scattered around the nest and roost trees revealed that this was supplemented with small numbers of Common Ringtail Possums and birds. The jawbone and skull of a Long-nosed Bandicoot were recorded amongst other larger off-casts at the base of one of the trees. During the early part of the breeding season, the male hunted soon after dusk. He was joined by the female in late spring. Pairs have been reported to hunt in tandem to flush rabbits, usually by quartering low over openings in lightly timbered country. They then fly to a tree to dismember and devour their prey. On occasion at Cottles Bridge (both in the Diamond Creek valley and at Dunmoochin), birds have been observed sitting quietly in a tree, presumably on the look-out for prey. Other sources list large insects and rats as occasional items.

There has been a substantial decline in the range and abundance of the Masked Owl since European settlement (Blakers *et al.* 1984). Rarity in the foothills of NEM is clearly due to the lack of mature hollow-

bearing trees along creeks and gullies. Few have escaped the logging, mining and land clearing episodes. There would not be a single Manna Gum along Diamond Creek between Cottles Bridge and St Andrews that exceeds 100 years of age. Most are around 50 years. Trees with hollows of the size required by species such as the Masked Owl and Powerful Owl need to be 150-200 years minimum age. The nest-tree at Cottles Bridge survived by virtue of the remoteness and steep nature of the surrounding terrain. Decline of the Masked Owl is also linked with the loss of native food and cover from land clearing and livestock grazing and predation of their prey by foxes and cats. This has been partly offset by the abundance of rabbits. Before settlement, their likely prey would have included the Eastern Quoll.

The Masked Owl has a propensity to sit on fence posts along roadsides or fly low over roads. High speed motor traffic has created a significant threat and road-kills are picked up in south-eastern Victoria where the species is apparently more plentiful (still rather uncommon). No road-kills have been located in NEM over 20 years of casual searching. This supports the scant field survey records, suggestive of its local and overall rarity in central and western Victoria.

75^b: Painted Honeyeater. They nested several times in the 1970s in a Yellow Box (valley forest; 31.1) along the Heidelberg–Kinglake Road, near the St Andrews football oval. The Yellow Box in the locality contained dense clumps of Drooping Mistletoe, the fruit of which is their principal food in GM.

Bc **75^c: Brush-tailed Phascogale.** A road-killed male was found on the Heidelberg–Kinglake Road near the Cottles Bridge–Strathewen Road on 17 January 1993. According to the literature, mid-January is when the young first become independent and males disperse widely. The carcass was very fresh when picked up in the morning. The animal was probably hit around daybreak and the foxes had not yet located it. Loss of connectivity between habitat patches, leading to road mortality and cat predation, is the most important threatening factor operating on the species in the more sparsely settled parts of the shire.

Bc **75^a: Freshwater Blackfish.** One electrofished at Watts Lane along Diamond Creek on 15 April 1992. This was the only blackfish recorded at the seven electrofishing sites in Diamond Creek. They were plentiful only two decades ago. Occasional blackfish are caught a little upstream behind the St Andrews oval (Aaron Saper pers. comm.). This section contains several deep holes suitable for blackfish. The Short-finned Eel and Mountain Galaxias were seen on this occasion. The apparent poor water quality of the creek downstream of St Andrews (due to domestic water outfall and septic tank leachate) may eliminate the blackfish and galaxias unless positive steps to reduce the pollution sources are taken (see Regional Hydrological Strategy).

Critical Assemblages and Populations

Cf **75^a: High diversity of migratory insectivorous birds.** The mid-Diamond Creek is one of the most important areas in GM for these species. Twelve canopy species were recorded breeding during the 1990 grassy/gully woodland census near Watts Lane. Three nesting pair of the rare White-throated Gerygone were present. Rufous Songlarks have nested several times over the last decade in Yellow Box–Candlebark valley forest (31.1) along the census transect (Brewers Track) and also by the Kinglake Road near Watts Lane.

Fi **75^a: High population density of bats.** An individual trap capture of 61 bats of five species was made along Diamond Creek downstream of Watts Lane on 13 March 1988. On the following night a sixth species was trapped. This was the locally rare, upland Gould's Long-eared Bat. The trap, which had been in position for several days, was placed under overhanging branches of a Manna Gum on the floodplain terrace (riparian forest; 5.2). Earlier weather conditions had been warm but had failed to return bats. The night of the capture followed a heavy rainstorm and cooler temperatures. This was the second highest individual trap capture for NEM. The highest was 70 under Mountain Ash at Mt Disappointment on 27 March 1988. The only higher individual capture in GM was a phenomenal 168 trapped under Grey Box at Radar Hill, Melbourne Airport in February 1991.

Other significant fauna

Birds

Eb **75^c: White-bellied Cuckoo-shrike.** The voice is loud with a distinctive ‘two-note’ call, strikingly different from the Black-faced Cuckoo-shrike. The two cuckoo-shrikes are otherwise similar in appearance and behaviour. This species is very rare in GM. They mainly inhabit River Red Gum woodlands along watercourses across the foothills of the Great Dividing Range in northern Victoria. Small numbers extend into southern Victoria every few years. At these times they are partial spring migrants, arriving in early November, later than most of the migratory insectivores. A pair nested in Yellow Box–Candlebark grassy woodland (14.6) near the Cottles Bridge–Strathewen Road bridge in 1990. They were first observed in mid-November, and remained in the locality with their young until around mid-February 1991. This was the only sighting in the Shire of Nillumbik during the study and one of only five made in GM. Their occurrence along Diamond Creek, like that of the Little Friarbird and Dollarbird, gives the area a northern Victorian avifauna character.

Eb **75^a: Little Friarbird.** These had not been seen for several years. A small group arrived at the St Andrews market grounds in late October 1987. The Yellow Box flowered through November and the birds remained and nested. On 28 December, a pair was seen feeding two young. The heaviest flowering of the Manna Gums seen in almost a decade commenced two months later along Diamond Creek. Four birds were later seen at Watts Lane on 22 February 1988.

Ed **75^c: White-browed Woodswallow.** Three pair nested in Manna Gum riparian forest (5.3) upstream of the Cottles Bridge–Strathewen Road bridge in November 1991.

Ee **75^a: Buff-banded Rail and Brown Quail.** Both species are cover-dependent floodplain species. They were recorded on the grassy floodplain terrace of Diamond Creek in Manna Gum riparian forest (5.2). The understorey consisted of Tall Sedge and Sword Tussock-grass. In the winter or after heavy rain at other times of the year, these areas become productive seasonal wetland habitat. The Brown Quail was observed near the bend in the creek downstream of Goldmans Road on 23 March 1991. Their dusk calling has been heard at this location on warm nights in late October and early November. The rail had been observed in the same locality on 27 February 1988.

75^a: Olive Whistler, Pink Robin, Eastern Whipbird and Bassian Thrush. Each is a winter visitor from the ranges to the dense groves of Hazel Pomaderris and Silver Wattle along the creek near Watts Lane.

75^a: Valley forest/gully woodland bird census: Watts Lane–Brewers Track Cottles Bridge. Ten 2 ha/20-minute counts were conducted in October 1989/90. The census plot was a 500 m transect 40 m wide along Brewers Track, commencing about 300 m from the Watts Lane bridge on Diamond Creek. The track follows along the south side of a gully and the plot is situated amongst an extensive stand of bushland.

Degree of fragmentation: low (three sides connected bushland; a small area of cleared land occurred at the Watts Lane end of the census plot). Degree of thinning: medium (tree density of 240/ha). Degree of understorey and ground degradation: low (intact shrub and herb layers; dense shrubs along the gully).

Vegetation. The plot consists of a band of Messmate–Mountain Swamp Gum gully woodland (10.2) adjacent to a band of Yellow Box–Candlebark valley forest (31.1). Red Stringybark herb-rich foothill forest (6.1) occupies the sheltered hill-slope west of the track and Red Box–Red Stringybark box–stringybark woodland (11.1) occupies the exposed hill-slope east of the track. Trees/ha (30% cover): 55 Red Stringybark, 50 Candlebark, 46 Yellow Box, 39 Long-leaf Box, 30 Red Box, 10 Swamp Gum and 10 Narrow-leaf Peppermint. Tall shrubs (20% cover); low shrubs: (20% cover); herbs: (50% cover).

Results. Bird summary: 53 species and 955 individuals recorded (26 forest, 11 woodland, 14 shrubland and 2 fragmentation species); 47.8 birds/ha composed of 25.9 (54%) forest, 5.3 (11%) woodland, 15.9 (33%) shrubland and 0.7 (2%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (4.2), Spotted Pardalote (4.0), White-naped Honeyeater (4.0), Rufous Whistler (1.4), Buff-rumped Thornbill (1.3), Weebill (1.1), Yellow-faced Honeyeater (1.0), White-throated Treecreeper (1.0), White-throated Gerygone (0.9), Crimson Rosella (0.9), Red-browed Treecreeper (0.8), Sacred Kingfisher (0.6), Shining Bronze-Cuckoo (0.6), Satin Flycatcher (0.5), Olive-backed Oriole (0.5), Grey Currawong (0.5) and Australian Raven (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (1.7), Leaden Flycatcher (1.0), Fan-tailed Cuckoo (0.7), Laughing Kookaburra (0.5) and Black-faced Cuckoo-shrike (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (3.2), White-browed Scrubwren (3.0), Grey Fantail (2.1), Silveryeye (2.0), Golden Whistler (1.3), Brown Thornbill (1.3), Red-browed Firetail (0.8), Eastern Yellow Robin (0.8) and Grey Shrike-thrush (0.8)

Fragmentation species with densities exceeding 0.5/ha included the Common Blackbird (0.6)

Parrots: 3 species and 1.4 birds/ha. **Canopy insectivores—migratory:** 12 species and 7.4 birds/ha; **non-migratory:** 7 species and 16.0 birds/ha.

Discussion. There were 47.8 birds/ha, 23.4 of which were tree canopy insectivores (i.e. half of the birds present were dieback control agents). The plot contains one of the most intact and extensive grassy/gully woodland systems in NEM. There is a strong similarity between the data from this plot and that from the Dulcet Gully Willis Nature Reserve census plot. Fragmentation species were the lowest level of all 16 census plots. Note also the high level of shrubland birds (15.9 birds/ha). The regionally depleted Leaden Flycatcher was the second-most abundant migratory insectivore in the census and three pairs were nesting during the 1990 census. Three pairs of the regionally vulnerable White-throated Gerygone were also nesting in 1990. This was the highest density recorded for this species in the 16 census plots. The canopy insectivores, the Striated Thornbill, White-naped Honeyeater and Spotted Pardalote, were by far the most common birds on the census. This and the absence of Bell Miners were the major factors why leaf psyllid and skeletoniser damage was low.

Conclusion. High diversity and viable populations of insectivores. An excellent bird watching area.

Mammals

Ec **75^a: Long-nosed Bandicoot.** There was evidence of diggings and scats in gullies and amongst Spiny-headed Mat-rush on the lower sheltered escarpment and creek terrace near Watts Lane on 14 March 1988. The presence was confirmed when a road-killed animal was observed near Watts Lane in August 1990. Skeletal remains were also identified under a Masked Owl roost tree in 1994. Few other diggings were located along the creek from Cottles Bridge to St Andrews on 28 October 1989. Bandicoots are apparently thinly scattered along intact sections of the creek. These populations are fragmented as several intervening sections of the streamway are cleared or degraded. Their future, given predation from cats and foxes and continued habitat loss and degradation, is under threat.

Freshwater fish

75^a: Electrofishing Survey: Diamond Creek–Watts Lane at Cottles Bridge

Map reference. 7922 446363. **Altitude.** 110 m. **Survey date.** 15 April 1992.

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum (creek) riparian forest (5.3; good condition). Frontage: Manna Gum (floodplain terrace) riparian forest (5.2; fair condition); Narrow-leaf Peppermint herb-rich foothill forest (6.2; good condition)

Physical Features

Pools

Substrate. Silt, logs, and branches on sheet siltstone

Maximum size (mid-autumn). 4.0 m wide by 1.0 m deep by 50 m long

Riffles

Substrate. Pebbles, gravel, cobbles on sheet siltstone

Flow (mid-autumn minimum): Size. 0.5 m wide by 2 cm deep. **Velocity.** 0.2 m/sec. **Rate.** 0.5 ML/day

Flow (mid-winter normal): Size. 4.0 m wide by 10 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 38 ML/day

Water quality

Autumn: Temperature. 17.0°C. **Conductivity.** 310 ms. **Salinity.** 0 ppt. **Turbidity.** Cloudy

Winter: Temperature. 10.0°C. **Conductivity.** 200 ms. **pH.** 7.15. **Dissolved Oxygen.** 11.2–11.4 ppm. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Freshwater Blackfish (1); likely breeding resident

Alien species numbers/status. Roach (28); likely breeding resident

Other comments. Mountain Galaxias were recorded just upstream in February 1988. They are rare in this section due to high levels of turbidity/siltation, inadequate water flow and competition/predation by Roach. The only Freshwater Blackfish taken from Diamond Creek system in the electrofishing survey was at this site. Lack of instream breeding habitat such as hollow logs may be a limiting factor. This is a long-term effect of prior logging as few hollow limbs are present on the riparian trees to fall into the creek. In farmed sections, logs are removed from the water's edge and dead trees are cut for firewood. Loss of flow, declining water quality, heavy siltation and predation of young by Roach are each endangering blackfish in the stream. A Platypus was seen in winter 1991. Land tenure is freehold bushland.

Butterflies

Df **75^a: Diamond Creek valley at Watts Lane.** Thirty one species recorded from seven monthly visits between October 1992 and April 1993. The site contains several mountain species (e.g. Flame Skipper, Yellow-spot Jewel and Banks Brown). On the basis of habitat (Yellow Box heavily infested with Box Mistletoe) there is potential for the vulnerable Genoveva Azure to be present.

Habitats surveyed:

- Manna Gum riparian forest (5.2/5.3): floodplain and creek banks
- Narrow-leaf Peppermint herb-rich foothill forest (6.2): sheltered escarpment west of the creek
- Messmate–Mountain Swamp Gum gully woodland (10.2): valley north-west of Watts Lane bridge
- Red Box–Red Stringybark box–stringybark woodland (11.1): exposed hill-slopes east of the Kinglake Road and hill-crests west of Diamond Creek
- Red Stringybark box–stringybark woodland (11.3): cutting along the high side of the Heidelberg–Kinglake Road, north of Watts Lane
- Yellow Box–Candlebark valley forest (31.1): valley north-west of Watts Lane bridge and along the lower side of the Kinglake Road north of Watts Lane.

Significant species:

- *Donnysa* Skipper: pupae in Thatch Saw-sedge on the sheltered escarpment and in the valley west of the creek in October 1992 and adults in same location in December; 6.2/10.2
- Spotted Skipper: single adults on flowering Woolly Tea-tree at Watts Lane bridge and flowering Hoary Sunray on the Kinglake Road cutting north of Watts Lane in November 1992; probably breeding in the *Donnysa* Skipper habitat; 5.3, 11.3
- Flame Skipper: adult on flowering Sweet Bursaria on the creek bank downstream of Watts Lane bridge in January 1993; probably breeding in the *Donnysa* Skipper habitat; 5.3
- Bright Shield Skipper: adults on flowering Sweet Bursaria along the Heidelberg–Kinglake Road in January 1993; 31.1
- *Phigalia* Skipper: adults on flowering Hoary Sunray on the Kinglake Road cutting north of Watts Lane in November 1992; 11.3
- *Phigalioides* Skipper: adult on flowering Mountain Tea-tree on the creek bank downstream of the bridge in December 1992; 5.3
- *Symmomus* Skipper: several adults on late flowering Sweet Bursaria downstream of the bridge in March 1993; breeding in Spiny-headed Mat-rush in the valley north-west of Watts Lane bridge; 5.2, 5.3, 10.2
- Cyril's Brown: several adults on flowering Snow Daisy-bush near Watts Lane south-east of the bridge in late October 1992; 5.2
- Bank's Brown: adult in the gully north-west of Watts Lane bridge in April 1993; 10.2
- Spotted Brown: breeding in the gully north-west of Watts Lane bridge in late January 1993; 10.2

- Meadow Argus: adult on flowering Hoary Sunray on the Kinglake Road cutting north of Watts Lane in November 1992; 11.3
- Dark Purple Azure: pupae and adults in December 1992/January 1993 in Creeping Mistletoe on Red Box above the main road; 11.1
- Yellow-spot Jewel: small breeding colony (scattered eggs, larvae and pupae) in Hazel Pomaderris along Diamond Creek (also upstream toward St Andrews); adult seen in December 1992; 5.3
- Bright Copper: breeding on Sweet Bursaria on the sheltered escarpment west of the bridge; adult seen in January 1993; 6.2
- Common Imperial Blue: breeding in stunted Silver Wattles near Watts Lane south-east of the bridge; 5.2
- Double-spotted Line Blue: adults in flowering shrubs from December 1992 to March 1993; 5.2, 5.3, 11.2, 31.1
- Common Dusky Blue: breeding in Coarse Dodder-laurel south-east of Watts Lane bridge and adults on flowering Sweet Bursaria in December 1992; 5.2, 5.3, 31.1.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. The site is the key habitat link between the upper and lower reaches of Diamond Creek. There are intact links to the Smiths Gully site and Diamond Creek Upper Reaches site and east through the Red Shirt Gully site to the Kangaroo Ground–St Andrews Road Red Ironbarks site. There are fragmented link downstream to the Wattle Glen to Hurstbridge site and overland to the Hurstbridge to Arthurs Creek site.</p>	
<p>Fragmentation and degradation of the downstream habitat link. See other Strategic Habitat Links including the Watsons Creek to Christmas Hills site (64) and Long Gully Link site (78).</p>	<p>Strengthen the Strategic Habitat Link.</p> <p>Conservation of the Public Land Water Frontage and Streamway Reserve and LandCare on private land. NRE must take an active role in the protection of this land. A LandCare group has formed to assist with streamway works on private land sections. Weed control and revegetation of a roadway strip along the streamway should be priority works.</p> <p>Recovery plan for the Long-nosed Bandicoot.</p>
Regional Hydrological Strategy	

Poor water quality and inadequate summer flow of Diamond Creek. See Diamond Creek Upper Reaches site. Electrofishing site at Watts Lane: moderate turbidity/siltation rate; depleted summer-autumn flow rate; roadway/bridge disturbance at Watts Lane; some nutrient enrichment, probably from septic tanks; inadequate native instream cover; some bank erosion—slumping, gullyng undercutting; advancing weeds. In autumn there was an inadequate amount of clean water coming down the stream to balance the loss of flow due to dams and input of polluted urban and track runoff and septic tank leachate entering from upstream.

Instream fauna recovery plans. Recovery plans for species such as the Freshwater Blackfish and Platypus will be necessary if they are to survive. A system needs to be devised for improving the summer flow and water quality of the stream.

Other Issues

Road-killed wildlife. The Heidelberg–Kinglake Road runs along one of the most important faunal habitat links in NEM. This is also the worst stretch of road with regard to road-killed wildlife in NEM. A survey of larger road-killed mammals was made over fortnightly intervals for six months in 1990. The tally was 13 Common Wombats (average of one per survey), 9 Common Brushtail Possums, 4 Black Wallabies, 4 Eastern Grey Kangaroos, 2 Echidnas, 1 Long-nosed Bandicoot and 1 Koala. The actual figure would be far higher as animals on the lower side of the road were difficult to detect. Many injured animals crawl away into the shrubbery to die. Dozens of frogs, snakes, blue-tongued lizards and birds, including nocturnal frogmouths and owls, were also seen but this number would be much fewer than the actual kill as foxes and scavenging birds remove the carcasses, often within minutes of them being hit. There are roadside populations of foxes which live off road-kills, often dying by the sword themselves (four road-kills during survey).

There has been perhaps a five-fold increase in the volume of traffic (particularly high speed night traffic) since the 1970s. A spate of human fatalities may lead authorities to straighten and widen the road (which is of little help to the wildlife) rather than addressing the excessive speed of motorists. The roadside verge contains Yellow Box–Candlebark grassy woodland (and its mistletoes) and Red Stringybark box–stringybark woodland. These are both threatened habitats in GM and the roadside stands are of high quality. The habitats are important for rare species of birds (e.g. Painted Honeyeater), butterflies (potentially the vulnerable Genoveva Azure), mammals (e.g. Brush-tailed Phascogale) and reptiles (e.g. Delicate and White's Skinks).

Road traffic speed limit on the Heidelberg–Kinglake Road. The wildlife carnage along the section of the road between Cottles Bridge and St Andrews requires a reduced speed limit. There should be a maximum speed limit of 75 km/hour and important fauna crossing points (often on the bends) should be signposted. Motorists should be encouraged to drive at slower speeds at night.

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat.

Site 76 Red Shirt Gully

- Map Reference:** 7922 430347 to 7922 443326 (Red Shirt Gully Creek); 7922 443340 (Red Shirt Gully Creek grassy/gully woodland census mid-point). One-minute lat/long grids include 37° 37' x 145° 14'.
- Location/Size:** Catchments of Red Shirt Gully Creek between Cottles Bridge and Panton Hill and encompassed by the Heidelberg–Kinglake Road, Church Road, Kangaroo Ground–St Andrews Road and Bellfield Road. Approximately 280 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Nil apart from road frontages owned by Vic Road. Private: much of the bushland has regenerated from previous clearing or timber harvesting. Farmlets (generally of horses and cattle) and bushblocks of 8 ha predominate in the site.
- Landforms:** Foothill (see NLH D). Elevation is 95–200 m.

Scientific and Educational Values

Scientific reference. Red Shirt Gully Road from about 300 m south-east of Bellfield Road to Majors Road forms a grassy/gully woodland census plot.

HABITAT SIGNIFICANCE:

Assessment: Very High—Category 3

Reference stands: Red Stringybark box–stringybark woodland (11.3; Red Shirt Gully Road)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Messmate–Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Endangered species: Rosella Spider-orchid

Vulnerable species: Wine-lip Spider-orchid

Rare/potentially threatened species: Bearded Greenhood, Daisy-bush (undescribed species; only known population in GM)

Critical Assemblages or Populations: One of only four remaining populations of the Rosella Spider-orchid; stands of bushland flanking Red Shirt Gully Road.

FAUNAL SIGNIFICANCE: Site 76 Red Shirt Gully

Assessment: State—Category 3 (B, E); Regional (C, D, E)

Reference grids for the significance keys include:

76^a: 37° 37' x 145° 14'; Red Shirt Gully Creek, Cottles Bridge

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 76^a: Square-tailed Kite (in passage), Swift Parrot (2 sightings)

c. Rare fauna

State. 76^a: Grey Goshawk, Barking Owl, Brush-tailed Phascogale, Common Dunnart

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 76^a: 9 species at the grassy/gully woodland census plot in October 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 76^a: 131 species

b. Native birds

Regional. 76^a: 105 species

c. Native mammals

Regional. 76^a: 14 species

d. Herpetofauna

Regional. 76^a: 12 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 76^a: 23 species

b. Regionally endangered fauna (R1 species)

Regional. 76^a: 3 species. **Birds:** Grey Goshawk, Square-tailed Kite, Western Gerygone

c. Regionally vulnerable fauna (R2 species)

State. 76^a: 10 species. **Birds:** Spotless Crake, Barking Owl, White-throated Nightjar, Black-eared Cuckoo, Red-capped Robin, White-throated Gerygone, Lewin's Honeyeater, Fuscous Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 76^a: 3 species. **Birds:** Collared Sparrowhawk, Pink Robin, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 76^a: 7 species. **Birds:** Buff-banded Rail, Whistling Kite, Swift Parrot, Leaden Flycatcher, White-winged Triller, Bassian Thrush, Speckled Warbler

f. Regionally restricted fauna (R5 species)

Regional. 76^a: 10 species. **Birds:** Painted Button-quail, Brush Bronzewing, Great Egret, Little Eagle, Barn Owl, Rainbow Lorikeet, Brush Cuckoo, Olive Whistler, White-winged Chough. **Reptiles:** Delicate Skink

Outlook

The faunal significance may decline from State to Regional if the current level of habitat fragmentation and degradation continues or if further bushblock housing development occurs. Species at greatest risk include the Brush-tailed Phascogale and Common Dunnart.

FAUNA

Rare or Threatened Fauna

Bb **76^a: Square-tailed Kite.** Single late autumn sighting of a passing bird (Noel Shaw pers. comm.).

Bb **76^a: Swift Parrot.** Two autumn sightings (Noel Shaw pers. comm.).

Bc **76^a: Grey Goshawk.** the grey-plumage form seen over adjacent open country in March 1992 and on one earlier occasion at Bellfield Road (Noel Shaw pers. comm.).

Bc **76^a: Barking Owl.** Recorded at Bellfield Road in Red Stringybark herb-rich foothill forest (6.1); (Noel Shaw pers. comm.).

Bc **76^a: Brush-tailed Phascogale.** Recorded at Bellfield Road in Red Stringybark herb-rich foothill forest (6.1); (Noel Shaw pers. comm.).

Bc **76^a: Common Dunnart.** Recorded at Bellfield Road in Red Stringybark herb-rich foothill forest (6.1); (Noel Shaw pers. comm.).

Other Significant Fauna

Birds

76^a: Bellfield Road birdlist. A birdlist containing 89 native species was provided by Noel and Margaret Shaw. The surrounding bushland contains Red Stringybark herb-rich foothill forest (6.1; sheltered hill-slopes), Messmate–Swamp Gum gully woodland (10.2; tributary of Red Shirt Gully Creek that runs through property), Red Box–Red Stringybark box–stringybark woodland (11.1; hill-crests and exposed hill-slopes), Red Stringybark box–stringybark woodland (11.3; exposed valleys) and Yellow Box–Candlebark valley forest (31.1; sheltered valleys). A dam contains Cumbungi emergent herbfield (25.7). Cleared farmland occurs on several neighbouring properties. An additional unentered species (White-bellied Sea-eagle) was seen flying over in a northerly direction in mid-November 1992.

Significant species

- Painted Button-quail: seen occasionally; 6.1, 11.1
- Spotless Crake and Buff-banded Rail: both seen amongst Cumbungi on the dam
- Barking Owl: heard on several occasions; 6.1, 11.1
- White-throated Nightjar: heard on occasions in late spring; becoming very rare; 11.1
- Bassian Thrush: rare winter visitor; 6.1, 10.2
- Western Warbler: a pair built a pendant nest in a Yellow Box; 31.1
- Fuscous Honeyeater: rare winter visitor to flowering Swamp Gum; 10.2
- Lewin's Honeyeater: seen on several occasions in late winter feeding on nectar/insects in flowering Tree Lucerne along Bellfield Road.

76^a: Winter bird visitors. The Pink Robin and Olive Whistler visit from the mountains in autumn–winter. Both were seen in the Black Wattle and Sweet Bursaria along Red Shirt Gully Creek near Majors Road on 9 May 1989.

Mammals

76^a: Overland habitat link along Red Shirt Gully Creek from Diamond Creek and Watsons Creek. The link is important for the recruitment of Common Wombats and Black Wallabies into the mid-Diamond Creek. Traffic speed and volume should be restricted along Red Shirt Gully Road to protect these animals.

76^a: Valley forest/gully woodland bird census: Red Shirt Gully Creek. Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot contained a 500 m transect 40 m wide in a strip along either side of Red Shirt Gully Road from about 300 m east of Bellfield Road to Majors Road. The plot was situated amongst an extensive and intact stand of bushland.

Degree of fragmentation: medium (cleared or partially land occurred at both ends of the transect; bushland occurred to either side). Degree of thinning: low (tree density of 275/ha; extensive eucalyptus regeneration from land clearing and the 1962 fires). Degree of understorey and ground degradation: low (intact shrub and herb layers; dense shrubs along the creek; grassy field layer on high side of road).

Vegetation. The transect comprised Messmate–Swamp Gum gully woodland (10.2) along Red Shirt Gully Creek, flanked by a band of Yellow Box–Candlebark valley forest (31.1) between Red Shirt Gully Road and the creek and a band of Red Stringybark box–stringybark woodland on the high side of Red Shirt Gully Road. Red Stringybark herb-rich foothill forest (6.1) occurred on the sheltered hill-slopes on the north side of the creek. Trees/ha (25% cover): 85 Red Stringybark, 65 Red Box, 50 Long-leaf Box, 40 Yellow Box, 28 Candlebark, 5 Swamp Gum and 2 Messmate. Tall shrubs (10% cover); low shrubs (10% cover); herbs (50% cover).

Results. Bird summary: 65 species and 982 individuals recorded (20 forest, 15 woodland, 19 shrubland and 11 fragmentation species); 49.1 birds/ha composed of 24.7 (50%) forest, 6.6 (13%) woodland, 14.1 (29%) shrubland and 3.7 (8%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (4.6), Buff-rumped Thornbill (3.4), Weebill (3.2), Spotted Pardalote (2.5), White-naped Honeyeater (1.9), Rufous Whistler (1.8), White-throated Treecreeper (1.2), Yellow-faced Honeyeater (0.9), Varied Sittella (0.8), Crimson Rosella (0.7), Sacred Kingfisher (0.7), Scarlet Robin (0.7) and White-winged Chough (0.6)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (2.6), Eastern Rosella (1.1), Fan-tailed Cuckoo (0.7), Black-faced Cuckoo-shrike (0.7), Leaden Flycatcher (0.6) and Speckled Warbler (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (2.9), Grey Fantail (1.9), Silvereeye (1.7), White-browed Scrubwren (1.4), Red-browed Firetail (1.2), Golden Whistler (1.0), Brown Thornbill (0.9), Grey Shrike-thrush (0.6), Yellow Thornbill (0.5) and Speckled Warbler (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Common Myna (1.0), Bell Miner (0.8), Common Blackbird (0.7) and Common Starling (0.6)

Parrots: 5 species and 2.0 birds/ha.

Canopy insectivores—migratory: 13 species and 5.7 birds/ha; **non-migratory:** 8 species and 19.4 birds/ha.

Discussion. 49.1 birds/ha, 20.0 of which were tree canopy insectivores (dieback control agents). The non-migratory canopy insectivores (Striated Thornbill, Buff-rumped Thornbill, Weebill, Spotted Pardalote, Striated Pardalote and White-naped Honeyeater) comprised well over a third of all birds counted. Of the high scoring sites for native species richness and density, this site had the highest levels of fragmentation species. This was attributable to nearby cleared farmland and a house at the west end of the transect. There was a high level of leaf psyllid and skeletoniser damage amongst the Swamp Gums, particularly near a house at the Bellfield Road end of the transect where a Bell Miner colony was resident. This was one of the best plots for shrub layer birds as it contained dense scrub on the low side of the road and open grassy sections with thickets of tall shrubs on the high side of the road. Red-capped Robins were present both years, breeding in 1989 in a Hedge Wattle on the high side the road. Speckled Warblers were also recorded on the high side in both years. Both species of bronzewings were present, the Brush Bronzewing being seen in the thick scrub near the creek. A Black-eared Cuckoo was seen in 1990.

Conclusion. High diversity and viable populations of insectivores. Ingression of fragmentation species near the house and farmland at the Bellfield Road end. A bushblock to the west side of the creek was subdivided and a house has been built. An excellent and accessible bird watching area.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Bushblock housing advance and habitat degradation. Further housing subdivision in the site will increase the rate of decline in the quality and quantity of understorey habitat. In the last 10 years many of the bushblocks have undergone cattle and horse grazing. Several important wildflower areas, including colonies of rare orchids, have been eliminated.</p>	<p>Habitat connectivity. The site contains the most important overland link from Diamond Creek. Intact links to the Cottles Bridge to St Andrews site and Kangaroo Ground–St Andrews Road Red Ironbarks site.</p> <p>Strengthen habitat links</p>
Regional Hydrological Strategy	
<p>Streamway degradation of the lower section of Red Shirt Gully Creek. The lower section runs through grazing land. This has caused the ingress of fragmentation bird species such as the Noisy Miner, Common Myna, Spotted Turtle-Dove and Common Blackbird. The creek bank has been severely damaged by livestock and over-run with weeds including Blackberry, Montpellier Broom, Bulbil <i>Watsonia</i> and Sweet Vernal-grass.</p>	<p>Revegetation of the streamway of the lower section of Red Shirt Gully Creek. Native vegetation in the streamway should be protected. The streamway needs to be fenced from livestock. Blackberry, Montpellier Broom and Spanish Heath need controlling in the upper section.</p>
Conservation Measures for Other Issues	
<p>Formation of a community land protection and conservation group. A LandCare group should form to protect this important habitat link. The group should focus activities on the significant sections of the streamway, particularly in the section downstream of Bellfield Road.</p> <p>Protection of blocks containing significant understorey vegetation. Conservation of the significant native flora and fauna species in the site would require all bushland, particularly the native field and shrub layers, to be protected. Grazing by livestock in these blocks should be restricted. An active public awareness exercise to reach all landowners is needed. The purpose and benefits of conservation covenants should be promoted to the landowners.</p> <p>Maintain low traffic flow and speeds along Red Shirt Gully Road. Other neighbouring roads such as Church Road and Gosfield Road that cross between the Heidelberg–Kinglake and Kangaroo Ground–St Andrews Roads take moderately heavy traffic. Road-killed animals are frequently seen along these roads. Red Shirt Gully Road is an important overland link for fauna between Diamond and Watsons Creek valleys. The road should be used for local traffic only to assist in maintaining a secure passage for wildlife.</p>	

NLH E PANTON HILL–LONG GULLY

This management unit consists of one site of state faunal significance (site 77) and one site of regional faunal significance (site 78) and surrounding land that forms habitat links.

Map Reference: 7922 441274 to 7922 467353 (southern to northern point) and 7922 434287 to 7922 478318 (western to eastern point).

Location/Size: Catchments of Watsons Creek occurring in an area bounded by the Eltham–Kingslake Road in the west, Eltham–Yarra Glen Road in the south and Clintons Road in the east and north. Part of the Watsons Creek Catchment and Yarra Ridge site (Mansergh *et al.* 1989). Approximately 1120 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. It contains the broad valley of Long Gully Creek, separating two ridges. One of the ridges runs along the western boundary and contains the section of the Eltham–Kingslake Road between Alma Road and Smiths Gully Road. The second ridge runs along the northern and north-eastern boundary and contains the northern end of Clintons Road. The Long Gully Creek and gullies and hills in the north-western section of the unit between Panton Hill and Smiths Gully contain the main Panton Hill goldfields. The St Andrews Anticline and associated outcropping Silurian siltstone/mudstone run along the western ridge of the unit. This ridgeline marks the divide between the Diamond Creek catchment to the west and the Watsons Creek catchment to the east. The headwaters of Long Gully Creek rise in a local divide formed by the junction of this ridge and a side ridge extending east along Clintons Road. The lower ground of Long Gully Creek and areas to the east are composed of Silurian sandstone. Bushland throughout the unit has been substantially fragmented by land clearing.

Landforms

Foothill: ridges, hill-crests, hill-slopes, gullies, valleys, creek and tributaries and dams. Elevation is 85–220 m.

Hydrology

Long Gully Creek is an ephemeral tributary of Watsons Creek, running during winter and after rains at other times of the year. In summer the creek contains shallow, static pools, exposed rocky reefs and dry cobble and gravel riffles with sandy banks. The creek channels are deeply scoured and the banks are undercut and have undergone severe slumping and erosion. This is a part legacy of alluvial mining activities. The water quality is poor, apparently contaminated by septic tank and domestic water outfall. The vegetation and physiography of the creek gives the impression that it may have once been perennial. Forest clearing and damming has had a significant impact. A second unnamed creek drains the area lying between Kangaroo Ground Hill and Alma Road. This joins Watsons Creek at the bridge on the Eltham–Yarra Glen Road.

Rainfall: 670–740 mm.

Site 77 Kangaroo Ground–St Andrews Road Red Ironbarks

- Map Reference:** 7922 445318 (Rankin Road Ironbarks census plot); 7922 460340 (Boomers Reserve grassy/gully woodland census plot); 7922 467340 (Long Gully Creek Ironbarks census plot); 7922 464350 (Franke's bushland). One-minute lat/long grids include 37° 37' x 145° 15' and 37° 38' x 145° 14'.
- Location/Size:** Two areas of Red Ironbark along the Kangaroo Ground–St Andrews Road between Panton Hill and Smiths Gully: one to the east of Kangaroo Ground–St Andrews Road between Alma Road and Long Gully Road (including the Rankin Road Ironbarks); the other to both sides of Kangaroo Ground–St Andrews Road between Howards Road and Clintons Road (including Boomers Reserve, the Long Gully Headwaters Ironbarks and Franke's bushland). Approximately 220 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Bushland Reserve and adjoining PPOS (Boomers Reserve–NRE); PPOS (Long Gully Headwaters Ironbarks between Blue House Road and Clintons Road and between Rankin Street and Long Gully Road in Panton Hill township and Panton Hill Recreation Reserve; Shire of Nillumbik). Much of the land was previously PPP 18 (Watsons Creek Dam Reservation), now surplus being disposed by Melbourne Water. Private: bushblocks between Bluehouse Road and Clintons Road (Long Gully Headwaters Ironbarks) and Bushland (bushblocks adjoining Panton Hill between Rodger Road and Bakehouse Road). Cattle and horse grazing farmlets and bushblocks.
- Landforms:** Foothill (see NLH E). Elevation is 130–200 m.

Scientific and Educational Values

Scientific reference. Three bird census monitoring points: grassy/gully woodland at Boomers Reserve and box–ironbark woodland in the Long Gully headwaters and at Rankin Street Reserve.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Red Ironbark box–ironbark woodland (12.1)

Relatively intact and extensive stands: Messmate–Swamp Gum gully woodland (10.2)

Partially intact or small stands: Messmate herb-rich foothill forest (6.3); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Endangered flora: Crimson Spider-orchid

Vulnerable flora: Wine-lip Spider-orchid

Rare flora: Bearded Greenhood

Critical assemblages or populations: Wine-lip Spider-orchid–Red Ironbark Critical Conservation Area. Strategic Habitat Link. Largest known population of the Wine-lip Spider-orchid in NEM. Rare or threatened orchids; high orchid diversity (50 species); reference stand of Red Ironbark box–ironbark woodland including a disjunct mountain heathland flora (e.g. Blue Dampiera).

FAUNAL SIGNIFICANCE: Site 77 Kangaroo Ground–St Andrews Road Red Ironbarks

Assessment: State—Category 3 (B, C, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

77^a: 37° 37' x 145° 15'; Boomers Reserve–Long Gully headwaters, Smiths Gully

77^b: 37° 38' x 145° 14'; Panton Hill township, Rankin Street to Long Gully Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 77^a: Regent Honeyeater (Long Gully headwaters on 6 June 1988 and 19 June 1991)

c. Rare fauna

Regional. 77^a: Powerful Owl, Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

State. 77^a: 12 species in a 2 ha/20-minute nectarfauna count at Long Gully headwaters on 6 June 1988 and 11 species on 19 June 1991

Regional. 77^b: 8 species in a 2 ha/20-minute nectarfauna count at Rankin Street Reserve on 19 June 1991

f. Breeding migratory insectivores

Regional. 77^b: 11 species recorded between Rankin Street and Long Gully Road at Panton Hill on 28 October 1991

k. Frogs

Regional. 77^a: 5 species including the Southern Toadlet and Victorian Smooth Froglet in the Long Gully headwaters on 2 May 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 77^a: over 70 species

b. Native birds

Regional. 77^a: over 50 species

c. Native mammals

Regional. 77^a: over 7 species

d. Herpetofauna

Regional. 77^a: over 8 species

e. Butterflies

Regional. 77^a: 27 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 77^a: 17 species

b. Regionally endangered fauna (R1 species)

Regional. 77^a: 1 species. **Birds:** Regent Honeyeater

c. Regionally vulnerable fauna (R2 species)

State. 77^a: 7 species. **Birds:** Red-capped Robin, White-throated Gerygone, Black-chinned Honeyeater, Lewin's Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater. **Mammals:** Brush-tailed Phascogale

Regional. 77^b: 1 species. **Birds:** White-throated Gerygone

d. Regionally rare fauna (R3 species)

Regional. 77^a: 3 species. **Birds:** Spotted Quail-thrush. **Reptiles:** Eastern Small-eyed Snake. **Butterflies:** Fringed Blue

Regional. 77^b: 1 species. **Birds:** White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 77^a: 6 species. **Birds:** Powerful Owl, Leaden Flycatcher, Bassian Thrush, Speckled Warbler. **Reptiles:** Red-bellied Black Snake. **Butterflies:** Spotted Brown

Regional. 77^b: 3 species. **Birds:** Leaden Flycatcher, Bassian Thrush, Speckled Warbler

f. Regionally restricted fauna (R5 species)

Regional. 77^a: 14 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog. **Butterflies:** Spotted Skipper, Phigalia Skipper, Dark Purple Azure, Bank's Brown

Local. 77^b: 4 species. **Birds:** Brush Bronzewing, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink

F. POPULATION DENSITY: Viability and Abundance—point census

e. Honeyeaters

State. 77^a: 311 of 12 species recorded in a 2 ha/20-minute count at Long Gully headwaters on 6 June 1988 and 302 of 11 species on 19 June 1991

Regional. 77^b: 117 of 8 species recorded in a 2 ha/20-minute count at Rankin Street Reserve on 19 June 1991

h. Other fauna

Regional. 77^a: A flock of over 100 Yellow-tailed Black-Cockatoos recorded at Boomers Reserve in late winter 1991

i. Regionally vulnerable fauna (R2 species)

Regional. 77^a: 6 Black-chinned Honeyeaters and 12 Fuscous Honeyeaters recorded in a 2 ha/20-minute nectarfauna count at Long Gully headwaters on 6 June 1988

m. Regionally rare fauna (R3 species)

Regional. 77^b: 12 White-browed Woodswallows breeding in the gully north of Rodger Road on 28 October 1991

Outlook

Continued fragmentation and bushland subdivision of stands of Red Ironbark may exclude the Regent Honeyeater and other rare nectivores such as the Yellow-tufted Honeyeater and Black-chinned Honeyeater and the faunal significance will decline from State to Regional. Maintenance of the current faunal significance depends on enhancing habitat links to redress the declining nectarfauna and vigour of the Red Ironbarks and on improved conservation management of the bushland areas.

FAUNA

Rare or Threatened Fauna

- Ba* **77^a: Regent Honeyeater.** One recorded in Red Ironbark box–ironbark woodland (12.1) at the Long Gully headwaters census of June 1988 and June 1991. Three birds were recorded on the census of June 1977. Two birds were recorded on the Rankin Street census of June 1977 (none present in 1988 and 1991).
- Bc* **77^a: Powerful Owl.** Observed since 1992 at Wyuna Nursery on the Kangaroo Ground–St Andrews Road (Kahn Franke pers. comm.). The area forms part of the home range of the Smiths Gully breeding pair (site 83).
- Bc* **77^a: Brush-tailed Phascogale.** A phascogale was observed in Red Ironbark box–ironbark woodland (12.1) at Franke’s bushland in the late 1980s (Kahn Franke pers. comm.). This is the only record for the site. The species is not easy to trap or detect while spotlighting and many of the records in the study were obtained from interviews with residents. Phascogales probably occur at low densities in the larger stands of herb-rich foothill forest and box–stringybark/ironbark woodland away from settlement in the site.

Other Significant Fauna

Birds

- Ec* **77^a: Red-capped Robin.** A pair in Red Ironbark box–ironbark woodland (12.1) on the north side of Bluehouse Road opposite Boomers Reserve on 19 June 1991. They are mainly winter visitors to the district as part of a post-breeding dispersal from inland Victoria. There is also a small resident breeding population (e.g. Red Shirt Gully Road and Pittles Paddock grassy/gully woodland census plots).
- Ec* **77^a: Lewin’s Honeyeater in the mature ironbark woodland of Long Gully Creek headwaters.** The main tributary of Long Gully Creek rises near the corner of Clintons Road and Smith Gully Road. The bushland supports some of the largest and healthiest ironbarks in NEM. They have not been as extensively logged as those on the Crown Land blocks such as Boomers Reserve. The combination of mature trees and tall shrubs along the gully support the highest diversity of birds in the site. The Lewin’s Honeyeater was first observed in the Red Ironbark box–ironbark woodland (12.1) nectarfauna census on 19 June 1991. It was recorded again in September 1992 in flowering Drooping Mistletoe on the ironbarks and Swamp Gums (Messmate gully woodland; 10.2).

The breeding habitat of this species is along mountain streams in association with Mountain Grey Gum damp riparian forest. It was recorded at four of these locations in NEM (the headwaters of the Plenty River, Arthurs Creek, Diamond Creek and Steels Creek). They were recorded elsewhere during winter in the Nillumbik Lowland Hills (see Red Shirt Gully site). The Lewin’s Honeyeater descends to the surrounding lowlands in search of nectar, returning to breed by mid-spring. The flowering Drooping Mistletoe in the Long Gully headwaters had also attracted about 10 Crescent Honeyeaters. These were breeding when a return visit was made in early October.

- Ed* **77^a: Spotted Quail-thrush—winter visitor to Boomers Reserve.** One amongst Red Box–Red Stringybark box–stringybark woodland (11.1) on the Grey Tussock-grass dominated north-facing slopes of the hill-crest in the east of the reserve on 19 June 1991. The ground layer is dry and open and contained a grass cover of about 30%, with ample areas of bare ground and leaf litter, a light cover of low shrubs (e.g. Narrow-leaf Bitter-pea and Common Heath) and scattered thickets of tall shrubs (e.g. Blackwood and Cherry Ballart). The bird was observed scratching over dry leaf litter and gleaning amongst the tussock-grass for invertebrates and seeds.

The Spotted Quail-thrush is now rare throughout the lowland hills of NEM, as a result of disturbance and habitat loss due to settlement and predation from cats and foxes. There are few breeding areas remaining in the lowlands and sightings are mostly of wintering upland birds. Retention and enhancement of forest links to the uplands and controls on the incursions of domestic cats into the bushland may be critical if the Spotted Quail-thrush is to continue visiting the site. Reduced predation pressure may enable them to remain in spring to breed.

Ee **77^{ab}: Bassian Thrush and Speckled Warbler.** Both recorded in the Long Gully headwaters on 2 May 1992 and at Panton Hill on 19 June 1991. The thrush was seen near a Burgan thicket under Messmate gully woodland (10.2) beside the main tributary of Long Gully Creek. At Panton Hill, one was observed below the fire station in the dense undergrowth of Red Ironbark box–ironbark woodland (12.1) between Bakehouse Road and Long Gully Road. The Speckled Warbler was seen in Red Ironbark box–ironbark woodland (12.1) amongst a group of Buff-rumped Thornbills foraging in Golden Wattles and Silvertop Wallaby-grass on the north side of Bluehouse Road opposite Boomers Reserve. At Panton Hill, a pair was observed in thickets of Sweet Bursaria, Black Wattle and Golden Wattle under Red Ironbark box–ironbark woodland (12.1) on the exposed hill-slopes of Rankin Street. (See Melbourne Water land disposal in Threatening Processes.)

Ef **77^b: Olive Whistler and Brush Bronzewing—winter visitors to Panton Hill.** An Olive Whistler was recorded amongst dense Burgan associated with Messmate gully woodland (10.2) below the scout hall at Bishops Road on 19 June 1991. They are winter visitors to the district from the ranges. The damp litter, moss beds and dense shrub layers provide the invertebrate food of the whistler. Prior to dusk, the bird was also seen hawking swarming craneflies amongst the outer foliage of the Burgan. The Olive Whistler has declined throughout the lowland hills of NEM due habitat clearing and possibly predation from cats. A Brush Bronzewing was also seen in the gully.

77^b: Migratory insectivorous birds at Panton Hill. Eleven species were recorded in bushland between Rankin Street and Long Gully Road on 28 October 1991. Breeding species included Rufous Fantails in the Burgan gully behind the scout hall and White-throated Gerygones, Leaden Flycatchers and Sacred Kingfishers along the main gully, north of Rankin Street. White-browed Woodswallows were breeding in tall shrubs in the large Swamp Gums along the gully on the north side of Rodger Road.

77^a: Red Ironbark nectarfauna census: Long Gully headwaters. The census plot was situated south of the corner of Smiths Gully and Clintons Road in a stand of 10 ha of Red Ironbark box–ironbark woodland (12.1) on two hill-crests on either side of the main tributary of Long Gully Creek. Peak flowering year 2 ha/20–minute counts were conducted on 14 June 1977, 6 June 1988 and 19 June 1991. The plot supported approximately 90 Red Ironbarks of which 40 were in heavy flower in 1977, 35 in 1988 and 30 in 1991. The gully supported Messmate–Swamp Gum gully woodland (10.2), while Red Stringybark and Messmate herb-rich foothill forest (6.1/6.3) flanked the sheltered hill-slopes of the tributary.

Long Gully headwaters: Results. 1977 bird summary: 12 species and 527 individuals recorded including the White-naped Honeyeater (250), Black-chinned Honeyeater (6), Brown-headed Honeyeater (130), Eastern Spinebill (2), Crescent Honeyeater (12), Fuscous Honeyeater (30), Yellow-faced Honeyeater (40), White-eared Honeyeater (3), Yellow-tufted Honeyeater (12), Regent Honeyeater (3), Red Wattlebird (30) and Little Friarbird (6).

1988 bird summary: 14 species and 381 individuals recorded including the White-naped Honeyeater (170), Black-chinned Honeyeater (6), Brown-headed Honeyeater (80), Eastern Spinebill (2), Crescent Honeyeater (10), New Holland Honeyeater (6), Fuscous Honeyeater (12), Yellow-faced Honeyeater (20), White-eared Honeyeater (3), Yellow-tufted Honeyeater (1), White-plumed Honeyeater (10), Bell Miner (10), Regent Honeyeater (1) and Red Wattlebird (60).

1991 bird summary: 13 species and 344 individuals recorded including the White-naped Honeyeater (150), Brown-headed Honeyeater (90), Eastern Spinebill (3), Crescent Honeyeater (10), New Holland Honeyeater (5), Lewin's Honeyeater (1), Fuscous Honeyeater (10), Yellow-faced Honeyeater (20), White-eared Honeyeater (2), White-plumed Honeyeater (10), Bell Miner (12), Regent Honeyeater (1) and Red Wattlebird (30).

Long Gully headwaters: Discussion. The Red Ironbarks are mature and flower heavily every three to five years. One Regent Honeyeater was present in 1988 and 1991 while three birds were present in 1977. The plot contained the only 1990s sighting in the Ironbark census study of a Regent Honeyeater. Twelve Yellow-tufted Honeyeaters were present in 1977 and one was recorded in 1988. Populations of both the Regent and Yellow-tufted Honeyeater have declined dramatically in NEM over the last two decades. This is related to a decline in vigour and increase in the level of foliage dieback of the Red Ironbarks (see Threatening Processes). This decline was reflected over the other seven nectarfauna census plots.

Six Little Friarbirds were present in 1977. This species was not recorded at any of the eight NEM nectarfauna plots in 1988 or 1991 and has ceased visiting the district at this time of year. Two of the largest populations recorded in recent years in NEM of the regionally vulnerable Black-chinned and Fuscous honeyeaters were observed in 1988. Most sightings of both species in NEM have been in flowering Red Ironbarks in the lowland hills. Both species move into the district from northern Victoria in the autumn and early winter of heavy flowering years. The Fuscous Honeyeater and Yellow-tufted Honeyeater have also been recorded in flowering Swamp Gums at this time. Black-chinned Honeyeaters have declined appreciably in the last two decades as a result of fragmentation of stands of Red Ironbarks. None of the above species have been recorded at nearby Boomers Reserve (see Threatening Processes).

The individual bird count fell by approximately 15% at the Long Gully Headwaters Ironbarks between 1977 and 1988. This is less than for most other Red Ironbark nectarfauna census plots in NEM, due in part to the presence of a higher proportion of mature trees (lower impact from past logging), which are less susceptible to dieback. The species count increased with the arrival of species (New Holland Honeyeater, White-plumed Honeyeater and Bell Miner) in the 1980s as a result of surrounding forest fragmentation. The decline in numbers of several species (notably the White-naped Honeyeater) has been partly compensated.

The Bell Miner is contributing to a dieback problem. The population and distribution has expanded in the district due to a combination of factors. These are: thinning and fragmentation of forest habitat; infestation of Blackberry along the creeks and gullies; and entrenchment of Burgan on hill-slopes.

77^b: Red Ironbark nectarfauna census: Rankin Street Reserve. The census plot was situated on hill-slopes on either side of a tributary of Long Gully Creek rising at the Kangaroo Ground–St Andrews Road between Rodger Road and Rankin Street Pantom Hill. It supported a stand of 10 ha of Red Ironbark box–ironbark woodland (12.1). Peak flowering year 2 ha/20–minute counts were conducted on 14 June 1977 and 19 June 1991. The plot supported approximately 50 mature Red Ironbarks of which 30 were in heavy flower in 1977 and 35 in 1991. The plot flanked a gully of Messmate–Swamp Gum gully woodland (10.2) with narrow bands of Red Stringybark herb-rich foothill forest (6.1) and Yellow Box–Candlebark valley forest (31.1) in the valley.

Rankin Street Reserve: Results. 1977 bird summary: 11 species and 386 individuals recorded including the White-naped Honeyeater (180), Black-chinned Honeyeater (7), Brown-headed Honeyeater (80), Eastern Spinebill (2), Crescent Honeyeater (15), Fuscous Honeyeater (20), Yellow-faced Honeyeater (40), White-eared Honeyeater (3), Yellow-tufted Honeyeater (12), Regent Honeyeater (2) and Red Wattlebird (25).

1991 bird summary: 10 species and 192 individuals recorded including the White-naped Honeyeater (50), Brown-headed Honeyeater (30), Eastern Spinebill (4), Crescent Honeyeater (6), New-holland Honeyeater (2), Yellow-faced Honeyeater (15), White-eared Honeyeater (4), White-plumed Honeyeater (6), Bell Miner (20) and Red Wattlebird (55).

Rankin Street Reserve: Discussion. The Regent Honeyeater was observed in 1977 but not in 1988, as the ironbarks failed to flower. In 1991 the ironbarks flowered heavily but the Regent was not observed. The individual nectarfauna count at the Rankin Street Ironbarks dropped by 50% between the 1977 and 1991 counts, particularly the melithreptids (White-naped and Brown-headed Honeyeaters) and meliphagids (Yellow-faced and Fuscous Honeyeaters). This is due to surrounding woodland fragmentation and bushblock settlement.

77^a: Valley forest/gully woodland bird census: Boomers Reserve. Ten 2 ha/20–minute counts were conducted in October 1989/90. The census was a 400 m transect 50 m wide, flanking both sides of a gully). The gully was a tributary of Long Gully Creek containing dense shrubland in the upstream section and sparse shrubland in the downstream section.

Degree of fragmentation: medium (two sides farmland, two sides forest). Degree of thinning: low (tree density of 296/ha; high density as a result of regeneration from fire and logging). Degree of understorey and ground degradation: low (naturally open shrub layers under this density of trees; intact herb layers with few weeds).

Vegetation. The plot was situated in a small stand of Yellow Box–Candlebark valley forest (31.1) flanking Messmate gully woodland (10.2). Red Stringybark herb-rich foothill forest (6.1) and Red Ironbark box–

ironbark woodland (12.1) occurred nearby on the hill-slopes. Trees/ha (25% cover): 100 Red Stringybark, 80 Long-leaf Box, 42 Red Box, 30 Narrow-leaf Peppermint, 24 Yellow Box, 10 Candlebark and 10 Messmate. Tall shrubs (5% cover); low shrubs (10% cover); herbs (50% cover).

Results. Bird summary: 45 species and 522 individuals recorded (19 forest, 11 woodland, 11 shrubland and 4 fragmentation species); 26.1 birds/ha composed of 16.1 (62%) forest, 4.0 (15%) woodland, 5.5 (21%) shrubland and 0.5 (2%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (4.4), Spotted Pardalote (2.1), Buff-rumped Thornbill (1.3), White-throated Treecreeper (1.3), Varied Sittella (0.9), White-naped Honeyeater (0.9), Weebill (0.8), Rufous Whistler (0.7), Gang-gang Cockatoo (0.6), Yellow-faced Honeyeater (0.6), Crimson Rosella (0.5) and Scarlet Robin (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (1.7), Eastern Rosella (0.9) and Black-faced Cuckoo-shrike (0.5)

Shrubland species with densities exceeding 0.5/ha included the Grey Fantail (1.0), White-browed Scrubwren (0.8), Superb Fairy-wren (0.7), Silvereeye (0.7), Golden Whistler (0.5), Grey Shrike-thrush (0.5) and Red-browed Firetail (0.5)

Fragmentation species with densities exceeding 0.5/ha: nil

Parrots: 5 species and 2.3 birds/ha. **Canopy insectivores—migratory:** 7 species and 1.9 birds/ha; **non-migratory:** 8 species and 12.1 birds/ha

Discussion. 26.1 birds/ha, 14.0 of which were tree canopy insectivores (dieback control agents). Canopy insectivores, particularly the migratory group (cuckoos) and the Buff-rumped Thornbill, Weebill and White-naped Honeyeater, were relatively scarce. This was a factor in the high levels of leaf psyllid damage observed. Their scarcity is attributed to the sparse foliage provided by the dense regrowth eucalypts (particularly the Red Ironbarks). Bushfires and logging have caused the ironbarks to produce spindly coppice and epicormic growth which does not provide cover for foliage birds. This foliage is readily attacked by foliage insects. As a result of the paucity of canopy species such as the Striated Thornbill, White-naped Honeyeater, Spotted Pardalote and Shining Bronze-Cuckoo, which control foliage insect populations, the ironbarks have undergone severe dieback.

Woodland birds are uncommon in the regrowth. Shrubland birds, particularly the flycatchers, are also poorly represented. This is attributed to the lack of tall shrubland vegetation. Fragmentation birds such as the Bell Miner and Little Raven are common in nearby farmland and fragmented forests. Further land clearing around Boomers Reserve would allow the entry of these species. The Bell Miners would facilitate further dieback amongst the Red Ironbarks and Swamp Gums.

Conclusion. Fragmentation of surrounding areas has lowered the density and diversity of insectivores.

Mammals

Ef **77^b: Koala at Pantan Hill.** One in a large Swamp Gum along the main gully between Rodger Road and Rankin Street at Rankin Street Reserve on 19 June 1988. The habitat was Messmate–Swamp Gum gully woodland (10.2). Koalas disperse along the creeks between the Yarra and Kinglake. The Long Gully Link is crucial to the resident population between Pantan Hill, St Andrews and Smiths Gully as the species is seldom observed in the more built up areas along the middle section of Diamond Creek.

77^a: Ground mammals at Franke's bushland. Vegetation consists of Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes, Messmate gully woodland (10.2) in the gullies and Red Ironbark box–ironbark woodland (12.1) on the hill-crest and exposed hill-slopes. The Brown Antechinus and Bush Rat are both present in gullies and on sheltered hills-slopes of Franke's bushland (Kahn Franke pers. comm.). Both species are scarce closer to Melbourne. The bushland has not been logged or picked over for firewood as heavily as the Crown Land blocks in the area (e.g. Boomers Reserve) and contains mature trees, ample ground logs and dense low shrub layers. This is important for the Brown Antechinus. The gullies contain stands of Thatch Saw-sedge and Spiny-headed Mat-rush, which are important for the Bush Rat. Other

gullies in the area have been more disturbed by alluvial mining and contain large populations of the introduced Black Rat.

Reptiles

77^a: Reptiles at Franke's bushland. Snake species seen include the Red-bellied Black Snake, Lowland Copperhead and a hibernating group of Eastern Small-eyed Snakes, uncovered from under a tree stump (Kahn Franke pers. comm.). The small-eyed snake grows to about 40 or 50 cm long and is a very attractive slate grey colour. The head is small and rounded, darker than the body. They are seldom met with and are nocturnal hunters of small skinks, such as Bougainville's Skinks, which are common in the bushland. Small-eyed snakes are venomous but do not present a threat to humans due to their small size and retiring nature. They are sometimes killed in the mistaken belief that they are small copperheads, which are the most commonly encountered snake in the area.

Butterflies

Ed **77^a: Fringed Blue.** This species was recorded in Red Stringybark herb-rich foothill forest (6.1) in the north-west section of Boomers Reserve in December 1992. This section was burnt in the mid-1980s. The larvae of the blue feed on developing flowers and fruit pods of bush-peas, bitter-peas and parrot-peas. They were observed on Golden Bush-pea at Boomers. The germination of these plants is stimulated by fire. The Fringed Blue has been located on only three occasions in recent years in NEM. Each was in an area burned in the previous six to ten years. Fringed Blues appear to colonise mid-successional fire regrowth, dominated by peas.

77^a: Boomers Reserve–Long Gully headwaters. Twenty-seven species were recorded. Boomers Reserve supports a high diversity of Satyrinids (browns) and Hesperids (skippers). Habitats are described in the bird census studies. These include 6.1, 6.3, 10.2, 12.1 and 31.1. A stand of Red Ironbark box–ironbark woodland (12.1) in the central section of Boomers Reserve occurs in an area of impeded drainage in a saddle at the head of a drainage line. The dense stand of Thatch Saw-sedge supports several species of skippers. Red Box–Red Stringybark box–stringybark woodland (11.1) occurs on a hill-crest and exposed hill-slopes in the east section of Boomers Reserve.

Significant species:

- Phigalia Skipper and Phigalioides Skipper: present in late spring–early summer; the larvae of both feed on the small mat-rushes
- Donnysa Skipper and Spotted Skipper: the larvae of both feed on the Thatch Saw-sedge, which is locally abundant
- Bright Shield Skipper: common skipper in summer; larvae feed on *Poa*
- Symmomus Skipper: moderately common amongst Spiny-headed Mat-rush (larval food-plant) in the valleys of the Long Gully Creek headwaters
- Cyril's Brown: fairly common in early spring
- Spotted Brown: about 20 seen in the flats above the main gully in March 1993
- Bank's Brown: several in the main gully in April 1993; the larvae of the browns feed on *Poa*
- Common Dusky Blue: larvae located on Downy Dodder-laurel.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. The Long Gully Creek and a tributary connecting Boomers Reserve forms the main habitat link between Watsons Creek and Diamond Creek. It shares intact links with the Long Gully Link site, the Smiths Gully Creek site and the Cottles Bridge to St Andrews site. The main connections extend over Clintons Road, east of Smiths Gully Road to the Smiths Gully Creek at Peter Franke Reserve and north-west, at the Smiths Gully store, crossing the Kangaroo Ground–St Andrews Road to the Franke block, and connecting the catchment of Diamond Creek. Partial links occur west to the Red Shirt Gully site.

Red Ironbark woodland habitat loss, fragmentation and thinning due to subdivision. With the exception of the Round the Bend Cooperative, where there is a high level of conservation awareness, this is occurring in stands of Red Ironbark throughout NEM. Most stands occur along ridgelines and hill-crests, where many bushblock houses and drives are situated. With the advance of housing the following scenario usually eventuates:

Over clearing for the homesite, drives, pool (etc.); grassy weeds spread from earthworks and effluent lines; surrounding woodland thinned to provide a view or firewood; bushland grazed by livestock/horses; rocks and logs removed from the ground (fauna habitat); grassland and prickly native shrubs brushcut/mown and replaced by lawns and non-indigenous shrubs; forest birds decline and fragmentation birds increase; surviving trees undergo dieback and slowly die.

Dieback of Red Ironbarks between Boomers Reserve and Panton Hill. Habitat link severance has reduced populations of beneficial insectivorous birds. Extensive timber extraction has made the regrowth ironbarks in areas such as Boomers Reserve more susceptible to insect attack. Continued habitat fragmentation by bushblock development and degradation of ironbark understorey from livestock grazing has enhanced the problem.

The ironbarks are being defoliated by psyllid insects and Gum-leaf Skeletonisers. The end result is dieback.

Strengthen habitat links. Protection and enhancement through revegetation of broken links (see Threatening Processes) and broadening the grassy/gully woodland strips will be required to maintain the present native fauna populations. The establishment of an integrated system of habitat links and buffers, both internal and external to the site is essential for fauna conservation. Enhancement of the link between Watsons Creek and Diamond Creek Headwaters site of Kinglake National Park will be essential for the successful operation of the Yarra to Kinglake Conservation Link (see Regional Habitat Link Strategy).

Further fragmentation, leading to tree dieback, must be prevented. An effective plan must be devised for linking the isolated stands along the Kangaroo Ground–St Andrews Road, preventing further fragmentation of ironbark blocks and reducing tree dieback and understorey degradation. Protection and enhancement of the Long Gully headwaters and external links are integral components of the Regional Habitat Link Strategy for the Shire of Nillumbik.

Flowering and nectar production rates of trees and visitation rates of nectarfauna have declined as a result of dieback. Further stand fragmentation and habitat link severance by housing encroachment will tip the delicate ecological balance to favour fragmentation bird species. See grassy/gully woodland census discussion.

Loss of effective habitat links. Substantially cleared farmland lies between the Rankin Street/Bakehouse Road bushland and Long Gully Creek. Westerly connections to the Diamond Creek catchment have been severed by rural and residential development at Panton Hill. The ground and shrub layer link between the Long Gully headwaters and Smiths Gully Creek has been eliminated by farmland. Westerly links from the Long Gully headwaters to the Diamond Creek catchment will be partially severed (for some ground fauna at least) by future bushblock development along the Kangaroo Ground–St Andrews Road.

Formulation of a Red Ironbark/nectarfauna conservation strategy—Regent Honeyeater management.

If the declining vigour of the trees and an ironbark management and research program which can break the dieback cycle is not addressed, a substantial and widespread decline in flora and fauna values of the ironbark woodlands will occur. This should include control of the level of weeds and Bell Miners and assessment of impact of bushblock settlement on forest fragmentation and the hydrological cycle (e.g. proliferation of farm dams). Over the last two decades the world population of Regent Honeyeaters has fallen to an estimated 100 birds. It is now one of the most endangered bird species in Australia. Stands such as the Red Ironbark woodland in Long Gully headwaters supporting recent sightings are of critical importance to the species.

All stands of Red Ironbark in NEM need to be protected from further habitat loss and degradation and managed for the conservation of honeyeaters. Land-use issues in areas of significant or sensitive habitat in need of address include bushblock development and associated habitat loss and degradation such as spread of weeds and animal pests (including companion animals), domestic timber harvesting, livestock grazing and recreational pursuits such as horse riding and off-road vehicle use.

Melbourne Water land disposal. Blocks owned by Melbourne Water at Panton Hill as part of the Little Watsons Creek Reservoir catchment, are now being disposed of and subdivided. Many of the blocks are significant wildflower areas. Many also support Red Ironbarks and a diverse honeyeater assemblage. Some of the blocks where wildlife survey was undertaken in this study in the late 1980s, now have houses (e.g. Bassian Thrush locality between Bakehouse and Long Gully Road). The remnant area of bushland has severe infestations of Monterey Pine and Sweet Pittosporum. The thrush is a ground forager and the takeover by Common Blackbirds has presented an aggressive food competitor. The Song Thrush was also noted on nearby lawns in house gardens at Panton Hill. Further bushland subdivision will favour both introduced species. These and predation from cats and foxes will eliminate the native ground thrush.

Implementation of a zoning overlay which conserves the Red Ironbark woodland. see Red Ironbark Conservation Zone in Planning Recommendations.

Other Issues

Non-implementation of public open space strategy. The excellent open space recommendations presented by Adams *et al.* (1985) and the Watsons Creek Consultative Committee report dated 16 April 1986 in response to these recommendations appear to be disregarded by NRE, Melbourne Water and the Shire of Nillumbik. The lack of management action displayed places one (*de facto* to those responsible) in the increasingly common and difficult situation of investing time/management resources to cover for these deficiencies in order for species such as the Wine-lip Spider-orchid to survive in NEM.

Implementation of the Proposed Public Open Space and Bushland Zones. The conditions and objectives outlined in the committee report require implementation under the relevant department and council statutory controls. The committee recognised the need to protect and enhance habitat links in the Long Gully Creek catchment. This forms a viable extension to the conservation link between Kinglake National Park and the Yarra River.

This study supports the consolidation of proposed public open space around Boomers Reserve into a Nature Conservation Reserve. Two links to Boomers Reserve are amongst the most important habitat links in NEM. Their protection is viewed as critical. These include

Lack of management presence and conservation works bushland reserves.

Issues include: escalating woody weeds such as Monterey Pine, Montpellier Broom, Cootamundra Wattle, Sweet Pittosporum, Spanish Heath, Sallow Wattle and Blackberry and grassy weeds such as Large Quaking-grass, Panic Veldt Grass, Sweet Vernal-grass, Yorkshire Fog and Bulbil Watsonia; vehicle entry and firewood removal; horse riding and the spread of weeds and erosion. Each combines to a substantial problem and a continuing decline in flora and fauna values.

- a south-eastern link to Long Gully Creek at Howards Road (allotment 96 and most of 95); and
- a north-eastern link to the Long Gully Creek headwaters at the corner of Clintons and Smiths Gully Road (allotments 6 to 10). The gully and sheltered hill-slopes of the south-eastern link to Long Gully Creek support several plant species not observed in Boomers Reserve (e.g. Pale Vanilla-lily). The Eastern Whipbird and Koala have been recorded in this area (discussed in site 78). This gully provides the most contiguous habitat link from the Watsons Creek catchment to the Diamond Creek catchment. Extensive weed and erosion control is required. Revegetation of cleared farmland to the north of the gully in the triangle between the corner of Howards Road and Bluehouse Road would be desirable.

The Long Gully Creek headwaters contain a mature stand of Red Ironbark and may be critical for the Regent Honeyeater and other honeyeaters. The section of Red Ironbark woodland in the north-eastern link on the north side of Bluehouse Road supports vegetation of comparable biological significance to that on the opposite side at Boomers Reserve. This includes a population of the vulnerable Wine-lip Spider-orchid. Several significant bird species including the Red-capped Robin have been recorded in this area. The woodland is more mature and supports hollows for species such as the Brush-tailed Phascogale. The ground strata is more open and provides potential habitat for the Common Dunnart. Many of the orchid species recorded in the ironbarks at Boomers Reserve are present.

Incorporation of the two links into a biological reserve is viewed as critical for the long-term conservation of genetic diversity and biological values at Boomers Reserve. It is also critical that management works are undertaken on weed control (particularly Monterey Pine, Sweet Pittosporum and blackberry) and erosion control in the gullies.

Most of the proposed public open space is still (after a decade since the proposal) being degraded (e.g. horses, vehicle tracks and spreading weeds). The grass/disturbances need to be controlled. Blocks in the proposed Bushland Zone are being likewise degraded. Several have already been sold by Melbourne Water. Under new ownership, conservation management guidelines outlined in the Adams report have been disregarded. The NEROC study recommends the urgent implementation of these zones and their stated purposes. It also recommends that Melbourne Water allocate resources into environmental education and provision/assistance with weed control programs for land-owners.

Conservation Measures for Boomers Reserve

Management. Other areas such as Rankin Street Reserve require similar attention.

NRE involvement

- 1 Vehicle access into Boomers Reserve has been closed and the boundaries with St Andrews and Bluehouse Road have been fenced. The entry of vehicles led to soil erosion and weed invasion of tracks, off-road damage to native vegetation, firewood removal and rubbish dumping. Control of Large Quaking-grass, Perennial Rye-grass, Brown-top Bent and Sweet Vernal-grass along the tracks is being undertaken.
- 2 Site rehabilitation; weed control and erosion repair. The Bluehouse Road and Kangaroo Ground–St Andrews Road frontages, internal loop track and gully and mining area need urgent attention. Programs to remove woody weeds including Monterey Pine, Montpellier Broom and Sweet Pittosporum have commenced. Other shrub species in need of control include the Sallow Wattle, Cootamundra Wattle, Irish Cherry, Boneseed and Spanish Heath.
- 3 Rare plant protection work. Weeding of alien grasses from significant areas is being undertaken.
- 4 Horse riding in the reserve. This activity is not permitted. Transgressions are still occurring and native vegetation trampling and weed invasion has resulted. Additional signs advising the prohibition of horse riding in the reserve and policing is required.
- 5 Upgrading of park ranger services. This will be vital for the maintenance of flora and fauna values. The current staff/resource allocation for Warrandyte State Park to undertake management activities needs to be upgraded. Additional allocation will be required for management of the proposed links to Long Gully Creek and Long Gully headwaters.

Other sources

- 1 Continued management input from the Shire of Nillumbik such as weed control along the Kangaroo Ground–St Andrews Road and Bluehouse Road.
 - 2 Establishment of a 'Friends of Boomers Reserve' group. Attempts to form a group, including leafletting local households, have been unsuccessful but such a formation is considered essential. A friends group would also need to focus management attention on land protection works along the streamway of Long Gully Creek and proposed public land links (particularly gullies) to Boomers Reserve. The formation of a LandCare group to manage private land areas effectively would be desirable. Interpretation of Boomers Reserve for formal wildflower walks has been a valuable nature education tool.
 - 3 Preparation of a conservation management plan, flora survey and vegetation map of the reserve.
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- Continuation of scientific research and rare orchid survey and management programs.

Planning Recommendations

Proposed Public Open Space and Bushland Zones. These zones and their stated purposes proposed by the Watsons Creek Land Consultative Committee should be implemented. Management should be in accordance with the purposes of the Regional Habitat Link and Hydrological Strategies. A system of proposed public land links and flora reserves was recommended in a report presented to the consultative committee (Adams *et al.* 1985). Consolidation of proposed public open space (flora reserve) links between Boomers Reserve and the Long Gully Creek at Howards Road (Link A; allotments 95 and 96), between Boomers Reserve and the Long Gully headwaters near the corner of Smiths Gully and Clintons Roads (Link B; allotments 6, 7, 8, 9 and 10) and between Rankin Street and Long Gully Road at Panton Hill township and the Long Gully Creek (Link C; allotments 65, 66, 67, 69, 71, 72, 73, 74, 91 and 92; see Long Gully Link site) will be necessary if the present high flora and fauna values are to be maintained. The links will require the provision or maintenance of strategic firebreaks.

Wine-lip Spider-orchid—Red Ironbark box–ironbark woodland Critical Conservation Area. The spider-orchid and the Red Ironbark woodland have been greatly affected by land clearing, hardwood logging, farming and settlement throughout their range in Victoria. The species and habitat are threatened. Occurrences of both in NEM are now highly fragmented. The population of the Wine-lip Spider-orchid in Boomers Reserve is the largest known for the species in NEM, and possibly Victoria (over 10% of the known population). Specific management will need to be conducted at Boomers Reserve in order to maintain the orchid. The Boomers Reserve–Long Gully headwaters stand of Red Ironbark woodland is by far the most extensive and intact occurring in a (proposed) biological reserve in NEM.

The boundaries of the proposed flora reserve represent the boundaries of the Critical Conservation Area. This area contains specific habitat conservation guidelines (in accordance with the Regional Habitat Link Strategy) and would require specific protection and management for the Wine-lip Spider-orchid such as prescribed ecological burning, weed control and hand pollination. It should contain provisions for enhancement of the habitat of the orchid elsewhere in the management unit. The protection and enhancement of the Wine-lip Spider-orchid population in the Critical Conservation Area is critical for the conservation of the orchid species in Victoria. Likewise, the Red Ironbark box–ironbark woodland habitat in the Critical Conservation Area is critical for the conservation of the Regent Honeyeater in Victoria.

Site 78 Long Gully Link

- Map Reference:** 7922 462304 to 7922 468343 (Long Gully Creek from Long Gully Road to 1200 m upstream of Bluehouse Road); 7922 453296 to 7922 437275 (unnamed creek from north-west of Watsons Creek township to north-east of Kangaroo Ground hill); 7922 438298 (Koos Road Reserve grassy/gully woodland census plot). One minute lat/long grids include 37° 38' x 145° 15', 37° 39' x 145° 14' to 145° 15' and 37° 40' x 145° 13' to 145° 14'.
- Location/Size:** Catchments of Watsons Creek lying between the Eltham–Yarra Glen Road at Kangaroo Ground and Clintons Road at Smiths Gully including the Long Gully Creek and an unnamed creek joining downstream of the Eltham–Yarra Glen bridge. Approximately 570 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Public Land Water Frontage (K1, LCC 1977; incorporated into the Long Gully Bushland Reserve–NRE); Bushland Reserve (Koos Road Reserve–NRE); PPOS (linking areas of Long Gully Creek between Bluehouse Road and Long Gully Bushland Reserve and a block lying between Rodger Road and Bakehouse Road Panton Hill–NRE/Shire of Nillumbik–formerly PPP 18 land of the Watsons Creek Dam Reservation which extended over the proposed catchment of the Watsons Creek Dam. Melbourne Water has been disposing of land in the upper dam catchment. Private: zoned Bushland (e.g. northern side of the junction of Alma Road and Long Gully Road and fringing the Open Space between Rodger Road and Bakehouse Road); Landscape Interest (e.g. along a creek between Alma Road and Koos Road Reserve and the catchment of the unnamed creek between Dawson Road and the Eltham–Yarra Glen Road). Large orchards, cattle and horse grazing farmlets (generally around 8 ha) and bushblocks.
- Landforms:** Foothill (see NLH E). Elevation is 85–200 m.

Scientific and Educational Values

Scientific reference. The site contains a valley forest/gully woodland bird census monitoring point (Koos Road Reserve).

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference stands: nil

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Manna Gum gully woodland (10.1); Messmate–Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Messmate herb-rich foothill forest (6.3); Red Stringybark box–stringybark woodland (11.3); Red Ironbark box–ironbark woodland (12.1)

Critical assemblages or populations: Strategic Habitat Link

Notable features: stands of Yellow Box–Candlebark valley forest.

FAUNAL SIGNIFICANCE: Site 78 Long Gully Link

Assessment: Regional—Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

78^a: 37° 38' x 145° 15'; mid-reaches of Long Gully Creek

78^b: 37° 39' x 145° 15'; lower reaches of Long Gully Creek

78^C: 37° 40' x 145° 13'; Koos Road Reserve

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 78^a: Barking Owl, Common Dunnart

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Regional. 78^C: 9 species from the Koos Road grassy/gully woodland census in October 1990

Regional. 78^a: 9 species at Long Gully Creek upstream of Howards Road on 23 November 1991

g. Breeding parrots

Regional. 78^a: 5 species including the Gang-gang Cockatoo along Long Gully Creek upstream of Howards Road on 23 November 1991

i. Arboreal mammals

Regional. 78^a: 4 species including the Sugar Glider and Feathertail Glider along Long Gully Creek at Bakehouse Road on 23 January 1992

j. Ground mammals

Regional. 78^a: 5 species including the Brown Antechinus on 20 November 1990 and 5 species including the Long-nosed Bandicoot and Bush Rat on 23 January 1992 along Long Gully Creek at Bakehouse Road

k. Frogs

Regional. 78^a: 7 species at Long Gully Creek upstream of Howards Road on 23 November 1991

l. Reptiles

Regional. 78^a: 9 species upstream of Howards Road on 23 November 1991 and 6 species downstream of Bakehouse Road on 23 November 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 78^{ac}: over 70 species

b. Native birds

Regional. 78^{ac}: over 50 species

c. Native mammals

Regional. 78^a: 18 species. **78^C**: 7 species

d. Herpetofauna

Regional. 78^a: 20 species. **78^C**: 10 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 78^a: 16 species

c. Regionally vulnerable fauna (R2 species)

Regional. 78^a: 5 species. **Birds**: Barking Owl, White-throated Nightjar, Cicadabird. **Mammals**: Common Dunnart, Long-nosed Bandicoot

Regional. 78^C: 1 species. **Birds**: White-throated Gerygone

d. Regionally rare fauna (R3 species)

Regional. 78^a: 4 species. **Birds**: Collared Sparrowhawk, Spotted Quail-thrush, Masked Woodswallow. **Mammals**: Feathertail Glider

Regional. 78^C: 1 species. **Reptiles**: White-lipped Snake

e. Regionally depleted fauna (R4 species)

Regional. 78^a: 7 species. **Birds:** Whistling Kite, Leaden Flycatcher, Eastern Whipbird, White-winged Triller, Speckled Warbler, Rufous Songlark. **Reptiles:** White's Skink

Regional. 78^c: 3 species. **Birds:** Rainbow Bee-eater, Leaden Flycatcher, Speckled Warbler

f. Regionally restricted fauna (R5 species)

Regional. 78^a: 12 species. **Birds:** Painted Button-quail, Brush Bronzewing, Nankeen Night Heron, Brush Cuckoo, Rose Robin, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Common Long-necked Tortoise, Delicate Skink, McCoy's Skink. **Frogs:** Striped Marsh Frog

Local. 78^c: 3 species. **Birds:** Brush Bronzewing, Red-browed Treecreeper, White-winged Chough

g. Nesting birds of prey

Regional. 78^a: Collared Sparrowhawk (stick-nest in a Swamp Gum in a gully downstream of Bakehouse Road in early December 1991); Gang-gang Cockatoo (Yellow Box hollow above Long Gully Creek upstream of Howards Road on 23 November 1991)

F. POPULATION DENSITY: Viability and Abundance—point census

h. Other fauna

Regional. 78^a: over 50 Yellow-tailed Black-Cockatoos near Bluehouse Road and Howards Road on 23 November 1991

Outlook

Under continued poor management the faunal significance will decline within Regional Category 1 (particularly through the loss of ground mammals such as the Long-nosed Bandicoot). Some rare nocturnal species, including the Powerful Owl and Brush-tailed Phascogale, may be present. The presence of both may elevate the significance to State Category 3. The site is a strategic habitat link. Habitat enhancement and conservation management would improve faunal connectivity to several adjoining sites and between the Yarra River and Kinglake National Park.

FAUNA

Rare or Threatened Fauna

Bc 78^a: Barking Owl. One calling in Yellow Box–Candlebark valley forest (31.1) by Long Gully Creek near the junction of Bluehouse Road and Howards Road on 12 January 1992. The area supports a substantial population of Sugar Gliders which are important prey of the owl. Several large Candlebarks were glider nest-trees.

Bc 78^a: Common Dunnart. One under debris amongst the ruins of an old shack south-west of the Long Gully Creek ford at Bakehouse Road on 23 November 1991. The area supports Yellow Box–Candlebark valley forest (31.1) and grassy understorey of Kangaroo Grass and Grey Tussock-grass.

Other Significant Fauna

Birds

Ec 78^a: White-throated Nightjar. One on a bare hill-crest under Red Box–Red Stringybark box–stringybark woodland (11.1) between Bakehouse Road and Rodger Road on 23 November 1991. Transient birds appear briefly in unusual situations on arrival in mid-October. The bird flushed from the ground to a nearby branch. This is one of only two recent sightings in the Nillumbik Lowland Hills. The nightjar, like other ground-dwellers such as the Spotted Quail-thrush and Bassian Thrush, has declined significantly in the lowland hills of NEM as a result of habitat loss and fragmentation caused by residential encroachment and predation from cats and foxes. These species inhabit large stands of bushland, but will vacate when a house or persistent human disturbance is located nearby.

78^a: Avifauna of the mid-reaches of Long Gully Creek. Surveys were conducted in November 1990 and 1991. The combined blocks fronting the west side of Long Gully Creek to the south of Bakehouse Road and each side of the junction of Bluehouse and Howards Roads support one of the most diverse Messmate–Swamp Gum gully woodland (10.2) and Yellow Box–Candlebark valley forest (31.1) avifaunas in NEM (Candlebark and Swamp Gum dominating at Bakehouse Road and Yellow Box and Messmate dominating at Bluehouse Road). The Candlebarks are important for the Painted Button-quail, Sacred Kingfisher, Jacky Winter, Leaden Flycatcher, White-winged Triller, Red-browed Treecreeper, Speckled Warbler, Spotted Quail-thrush and Olive-backed Oriole (each breeding or likely breeding). There are few spring records of the ground-dwelling quail-thrush closer to Melbourne (see White-throated Nightjar).

The Yellow Box are important for the Yellow-tailed Black-Cockatoo (feeding), Gang-gang Cockatoo (breeding), White-throated Gerygone and White-naped Honeyeater. The shrubby gullies of Burgan under Swamp Gum contain the Brush Bronzewing, Rose Robin, Satin Flycatcher and Rufous Fantail (each breeding or likely breeding). The Cicadabird and Brush Cuckoo were seen in Messmate herb-rich foothill forest (6.3) on the sheltered hill-slopes above the creek upstream of Howards Road (both species may have bred in the vicinity). Manna Gum gully woodland (10.1) along the creek contained the Collared Sparrowhawk, Eastern Whipbird and Masked Woodswallow (each breeding in 1991).

78^c: Valley forest/gully woodland bird census: Koos Road Reserve. Ten 2 ha/20-minute counts were conducted in October 1989–90. The plot was contained in a stand of 20 ha of bushland. The census was a 500 m transect 40 m wide crossing the creek valley in the centre of the reserve. Degree of fragmentation: high (three sides farmland, one side bushland). Degree of thinning: medium (tree density of 270/ha). Degree of understorey and ground degradation: low (intact shrub and field layers).

Vegetation. Messmate–Swamp Gum gully woodland (10.2) along a creek flanked on one side by Yellow Box–Candlebark valley forest (31.1) in the valley and on the other by Red Stringybark herb-rich foothill forest (6.1) on sheltered hill-slopes. Trees/ha (25% cover): 80 Red Stringybark, 76 Long-leaf Box, 60 Red Box, 23 Candlebark, 21 Yellow Box and 10 Swamp Gum. Tall shrubs (20% cover); low shrubs (10% cover); herbs (60% cover)

Results. Bird summary: 55 species and 964 individuals recorded (21 forest, 12 woodland, 16 shrubland and 5 fragmentation species); 48.2 birds/ha composed of 27.5 (57%) forest, 4.1 (9%) woodland, 14.7 (31%) shrubland and 0.9 (3%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (6.1), White-naped Honeyeater (4.2), Weebill (3.2), Buff-rumped Thornbill (2.9), Spotted Pardalote (2.7), Rufous Whistler (1.8), Yellow-faced Honeyeater (1.3), White-throated Treecreeper (0.9), Varied Sittella (0.8), Crimson Rosella (0.7), Brown-headed Honeyeater (0.6), Sacred Kingfisher (0.5) and Shining Bronze-Cuckoo (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (1.6), Eastern Rosella (0.9) and Fan-tailed Cuckoo (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (2.7), Silveryeye (2.4), Grey Fantail (2.1), White-browed Scrubwren (1.5), Golden Whistler (1.1), Brown Thornbill (1.1), Grey Shrike-thrush (1.0), Eastern Yellow Robin (0.9), Red-browed Firetail (0.8) and White-eared Honeyeater (1.6)

Fragmentation species with densities exceeding 0.5/ha: nil

Parrots: 2 species and 1.6 birds/ha. **Canopy insectivores—migratory:** 11 species and 4.0 birds/ha; **non-migratory:** 8 species and 22.5 birds/ha

Discussion. 48.2 birds/ha, 26.5 of which were tree canopy insectivores (dieback control agents). Of these, the thornbills were particularly prominent. There was a high density of forest and shrubland species. In October 1989, the flowering Red Box and Yellow Box had attracted large numbers of White-naped Honeyeaters. They had commenced breeding. The large Candlebarks and Yellow Box near the creek provide nest hollows for both species of rosellas and the Sacred Kingfisher. Forest fragmentation would increase the Common Myna and Bell Miner population. All groups of grassy woodland birds are well represented. Some gully woodland species such as the Red-browed Treecreeper, Brush Bronzewing and Rufous Fantail, were present in low numbers. A Rainbow Bee-eater was seen on 17 October 1989 passing over the census plot in the direction of the Yarra

River. The Wedge-tailed Eagles, which were breeding nearby at Watsons Creek, were seen in both years over the census plot. A Speckled Warbler was seen in October 1990.

Conclusion. Koos Road Reserve has a high density and richness of insectivores and is low in fragmentation species considering the size of the block and the farmland surrounds. The reserve is one of the best areas for bird watching in the district. Invading weeds are a major problem. Further stand fragmentation and thinning and habitat link severance will tip the delicate balance in favour of fragmentation bird species. Protection and enhancement through revegetation of severed links and broadening the grassy/gully woodland strip to Long Gully Creek will be required to maintain the present native forest, woodland and shrubland avifauna populations.

78^a: Yellow-tailed Black-Cockatoo. A flock of over 50 was seen near the junction of Bluehouse Road and Howards Road feeding on tunneller larvae in Black Wattles under Messmate–Swamp Gum gully woodland (10.2) on a tributary of Long Gully Creek and in Golden Wattles under Yellow Box–Candlebark valley forest (31.1) on the lower hill-slopes above the creek on 23 November 1991. This is an important feeding area for non-breeding flocks. They feed on ripening Monterey Pine kernels in late winter-early spring.

Mammals

Ed **78^a: Feathertail Glider.** One observed while spotlighting amongst dense Burgan and Blackwood in Messmate–Swamp Gum gully woodland (10.2) south of Bakehouse Road on 23 January 1992.

Ef **78^a: Koalas at Long Gully Creek.** Two sightings were made along Long Gully Creek. One in a tall stand of Yellow Box–Candlebark valley forest (31.1) in the creek valley near the Chinese puddle mines upstream of Howards Road on 23 November 1991 and the other in Manna Gum gully woodland (10.1) south of Bakehouse Road on 20 November 1990. The creek is the main link for Koalas moving between the Yarra and the St Andrews area.

78^a: Ground mammal trapping at Bakehouse Road. The poor capture rate in November 1991 from ground trapping in Messmate–Swamp Gum gully woodland (10.2) is a result of past land management (grazing and mining). The Long Gully Creek was an extensive alluvial mining area and the dominant species trapped was the introduced Black Rat. Small numbers of Brown Antechinus and Bush Rats persist in the protected gullies away from the creek. A Long-nosed Bandicoot was seen while spotlighting along the first gully (10.2; containing dense Sword Tussock-grass, Spiny-headed Mat-rush and Tall Sedge) south of Bakehouse Road. Protection of the downstream link along the creek to Watsons Creek (bandicoots recorded at the junction of Happy Valley Creek), is considered vital for the species in this site. They were not recorded from the more fragmented forest nearer Pantom Hill.

Reptiles and frogs

Ed **78^c: White-lipped Snake at Koos Road.** One located under a rock in a grassy sandstone area under Yellow Box–Candlebark valley forest (31.1) on 25 September 1988. The species is rare in the lowland hills.

78^a: Herpetofauna of the mid-reaches of Long Gully Creek. Surveys were conducted in November 1990 and 1991. Frogs, particularly the Verreaux's Tree Frog and Victorian Smooth Froglet, were common along the creek and damp gullies (Manna Gum and Messmate–Swamp Gum gully woodland; 10.1/10.2). These also contain populations of Blotched Blue-tongued Lizards and Weasel Skinks. The grassy field layer under the Yellow Box–Candlebark valley forest (31.1) contains the Tree Dragon, White's Skink (locally quite rare), Common Blue-tongued Lizard, Delicate Skink, Eastern Three-lined Skink and Lowland Copperhead (most common snake). The locally rare McCoy's Skink was located under a log on the sheltered hill-slopes under Messmate herb-rich foothill forest (6.3) upstream of Howards Road. This species is indicative of the damp sclerophyll forest element present in the upper reaches of the system (e.g. Messmate, Hazel Pomaderris, Rough Tree-fern and Forest Wire-grass).

MANAGEMENT

Threatening Processes	Conservation Measures

Regional Habitat Link Strategy

Habitat connectivity. There is a Strategic Habitat Link to the Watsons Creek to Christmas Hills site and the Kangaroo Ground–St Andrews Road Red Ironbarks site. It is the most functional link between Watsons Creek and Diamond Creek and an integral component of the Yarra River–Kinglake Ranges link—one of the most important links remaining in the lowland hills of NEM, given the increasing degree of habitat fragmentation and urbanisation along Diamond Creek and Plenty River.

Fragmentation of the Long Gully Link.

Bushblock development on private land along the link between Koos Road Reserve and Long Gully Creek has the potential to sever this already tenuous link.

Weeds and lack of management activity at the public land reserves.

There is inadequate management presence and conservation at the Long Gully Creek reserves. Weeds such as Montpellier Broom, Flax-leaf Broom and Spanish Heath are forming outbreaks along roadsides and advancing into the bushland. Long Gully Creek has a major problem. There are severe outbreaks of Blackberry, Bulbil *Watsonia*, Three-cornered Garlic, Japanese Honeysuckle and Cocksfoot along the creek. Weeds have the potential to run over Koos Road Reserve. Extensive outbreaks of Flax-leaf Broom have occurred along Kings Road, on the eastern side of Koos Road. The broom has been brought in by road grading, particularly along water diversion drains cut off the edge of the road into the bushland.

Strengthen Strategic Habitat Link.

Given the prospect of further fragmentation from land subdivision, the bushland along several sections of the creek is not wide enough to sustain an effective habitat link in the long term. Linking all the bushland along the creek is an integral component of the Regional Habitat Link Strategy. The critical issue will be proper management of the streamway (a strip of 100 m to either side of the creek) across private land sections between Koos Road Reserve and Alma Road and on Long Gully Creek between Motchalls Road and Broadacres Road. Protection and enhancement through revegetation of broken links (see Threatening Processes) and broadening the gully and grassy woodland bands along the valley will be required to maintain the present native fauna populations. Establishing an integrated system of habitat links and buffers, both internal and external to the site, is essential for fauna conservation. Enhancement of the link between Watsons Creek and Diamond Creek Headwaters site of Kinglake National Park will be essential for the successful operation of the Yarra to Kinglake wildlife corridor.

Grazing exclusion and revegetation of the Long Gully Creek streamway.

Livestock grazing on private land needs to be restricted from the streamway of Long Gully Creek and its major tributaries. This will facilitate regeneration and enable a more effective habitat link. Blocks with significant native understorey which have been ungrazed in recent years need to be protected from renewed grazing.

Regional Hydrological Strategy

150 years of poor land-use. Land and hydrological management practices in this site and throughout the catchments of the lowland hills of NEM have led to widespread degradation of biological values of third order streams. Past land management (e.g. mining, orchards, grazing and settlement) has given little regard to conservation of our most precious resource—water. The list of poor land management practices is long. Some include: clearing vegetation and grazing to the stream edge and stock access into the catchment gullies—resultant erosion and weed invasion; effects of extensive earthworks of the alluvial mining era and intensive agriculture (orchards); polluting septic tank and waste water output from Pantan Hill and farm runoff; dumping of cars and other rubbish in gullies; horse riding and off-road vehicle driving in gullies.

The following account typifies what is happening throughout the foothills of NEM. The site was rated with regional faunal significance. It contains some excellent stands of bushland. These would be far more significant under a land management resulting from a raised awareness of conservation values. It is a testimony to how significant the site was that it still retains significance under the study criteria, given past (and likely future) land uses which conflict with flora and fauna conservation. No action has been taken to address the land and stream degradation.

Declining water quality and stream flow in Long Gully Creek. The creek is starved of runoff during summer–autumn because there are too many dams in an over cleared catchment. The polluted water stagnates in pools in Long Gully Creek. Potentially life-threatening to humans, the birds drink it and the native fish and Platypus of Watsons Creek breed in it. The nutrient enriched conditions have led to weed invasion. Subdivision in the catchment can be directly equated to further decline in water quality and altered water flow. Unaddressed, the process will inevitably diminish faunal values in Watsons Creek.

Melbourne Water land disposal and subdivision. Disposal of land for subdivision by Melbourne Water will continue the land and stream degradation process. Has the organisation researched the impact of further subdivision on the stressed Long Gully Creek and Watsons Creek ecosystems? What requirements are implicit on the purchaser for land and stream protection (e.g. water pollution controls, grazing controls in gullies, understorey vegetation protection, wandering cat and dog controls, dam building controls, incentives/requirements for conservation management, conservation covenants etc.)? Has the long-term adequacy of habitat links under the broad-scale effects of increased subdivision been assessed? What are the likely environmental effects on conservation values of Watsons Creek?

Improve water quality and quantity in Long Gully Creek. The degradation of the stream ecosystem is directly related to land clearing, intensive agricultural use (e.g. orchards), land subdivision, the impact of a township in the catchment and poor farm management practices. This has impacted on the lower reaches of Watsons Creek which is the most significant second order stream in NEM for instream fauna. Strict land management controls need to be enforced in the catchment including protection from livestock access to gullies and restrictions on the building of farm dams. Any further subdivision will lower flora and fauna conservation values.

Covenanted/land-use controls before Melbourne Water land disposal. Significant bushland contained within the site, such as the block on the north-west corner of Alma Road and Long Gully Road owned by Melbourne Water and earmarked for disposal, needs to be accompanied by an appropriate conservation covenant on the title and land-use controls to protect conservation values.

Consolidation of the Long Gully Flora Reserve with Proposed Public Open Space and Bushland Zone linkages. See Planning Recommendations and the Kangaroo Ground–St Andrews Road Red Ironbarks site. The significant areas of stream frontage and bushland identified in the Melbourne Water/ Shire of Nillumbik Indicative Development Plan should be:

- transferred to the Department of Natural Resources and Environment
 - resourced/managed for essential nature conservation works
 - subject of a nature conservation land-use and management plan
 - assessed in accordance with LCC criteria as Nature Conservation Reserves or Natural Features Reserves.
-

Other Issues

Horse riding in significant and sensitive bushland. The section of Long Gully Creek between Howards and Long Gully Road is a popular horse riding path. It is also an important bird watching and mammal spotlighting area (see fauna significance). Over the period from 1987 to 1991, the erosion rate of gullies on the east bank was closely monitored. As the erosion spreads, the horse path takes the higher ground. One particular gully has moved several metres in three or four years, taking with it some large bursarias. The path now passes right through a patch of Pale Vanilla-lily (locally scarce) and has trampled the herbfield down. Some large fallen trees have been cut and removed to make an easier path. The area is important for reptiles which live under the logs.

Koos Road Reserve is also increasingly used by horse riders. It may be one the best and safest riding areas around, but the horses are really cutting up the tracks and the creek crossing. Side tracks radiate from the main track through significant orchid areas. Weeds spread by horses, such as Sweet Vernal-grass and Perennial Rye-grass, are spreading. Horse riding should be excluded from these reserves, even the main tracks, as there is no way of stopping transgressions into wildflower areas. Even if only a small percentage of riders transgress, the damage is high, given the fragility and significance of the bushland.

Require an integrated horse riding trail external to the site. The only way to reduce the level of horse riding in environmentally sensitive or significant areas such as Long Gully Creek and Koos Road Reserve is to set up linking tracks elsewhere. Watsons Creek Project Indicative Development Plan shows one just north of Pelling's corner on the Kangaroo Ground–Yarra Glen Road. More are needed in areas that are not damaging to the environment. Trail-bike riding in bushland areas needs to be similarly regulated.

Habitat protection—establishment of 'Friends of Koos Road and Long Gully Creek' group and upgrading of resource allocation for conservation management. See the Kangaroo Ground to St Andrews Road Red Ironbarks and One Tree Hill sites.

Require orchid management at Koos Road Reserve.

Fire protection. Given that Long Gully Creek is a north–south link, a fire prevention strategy will need to be formulated. Strategic access and firebreak points should be determined.

Recreational off-road vehicle usage. This activity near streams and in significant bushland is highly detrimental to the principles of nature conservation. A policy needs to be formulated, on limiting (through stringent regulation) or excluding this activity throughout public land areas in the Shire of Nillumbik

Planning Recommendations

Flora Reserve. As recommended in a land assessment report presented to the Watsons Creek Consultative Committee (Adams *et al.* 1985). The area proposed for flora reserve includes allotments 65, 66, 67, 69, 71, 72, 73, 74, 91 and 92 (between Bishop Avenue and Bakehouse Road on the east and west sides of Long Gully Creek) and allotments 13, 16 and 17 (Koos Road Reserve).

Proposed Public Open Space and Bushland Zones. These zones and their stated purposes proposed by the Watsons Creek Land Consultative Committee should be implemented. Management should be in accordance with the purposes of the Regional Habitat Link and Hydrological Strategies. A system of proposed public land links and flora reserves was recommended in a report presented to the consultative committee (Adams *et al.* 1985).

Consolidation of proposed public open space and bushland zone at Panton Hill township, Long Gully Creek and Boomers Reserve/Long Gully headwaters will be necessary if the present flora and fauna values of this site and the Kangaroo Ground–St Andrews Road Red Ironbarks site are to be maintained.

VOLUME 5

UPLAND HILLS

Nillumbik Upland Hills (NUH)

NUH A. One Tree Hill–Watsons Creek Upper Reaches

- Site 79. Kinglake National Park Link
- Site 80. One Tree Hill–Watsons Creek Link
- Site 81. Watsons Creek–Yarra Ridge

NUH B. St Andrews–Smiths Gully

- Site 82. Diamond Creek Upper Reaches
- Site 83. Smiths Gully Creek
- Site 84. Yow Yow Creek–Wild Dog Creek

NUH C. Strathewen

- Site 85. Arthurs Creek Upper Reaches
- Site 86. Chadds Creek
- Site 87. Hewitts Road

Plenty Upland Hills (PUH)

PUH A. Doreen–Nutfield–Deep Creek–Running Creek

- Site 88. Deep Creek–Running Creek
- Site 89. La Trobe Downs–Doctors Gully Creek
- Site 90. Stewart Ponds Creek

PUH B. Yan Yean Reservoir and Catchment

- Site 91. Ridge Road–Sherwin Range Catchment–Reference Area
- Site 92. Yan Yean Reservoir and Plantations

PUH C. Upper Plenty–Eden Park

- Site 93. Eden Hills
- Site 94. Upper Plenty

HABITATS of the Upland Hills

3.1. Damp Riparian Forest

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 86^b

Partially intact or small stands: NUH B, 85^b

Distribution: localised in NUH B/C where flanking the ranges (e.g. Diamond Creek at upper Ninks Road)

Landforms: foothill—perennial streams and adjacent sheltered gullies above 250 m elevation

Canopy: Mountain Grey Gum; with Messmate, Narrow-leaf Peppermint and Manna Gum and Soft Tree-fern, Silver Wattle, Blackwood and Austral Mulberry in the mid-strata; 30–40 m tall and 20–30% cover

4.1. Damp Sclerophyll Forest—plateau/spur

Conservation status: regionally secure

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 91^b

Distribution: localised in PUH (small stand by Coombs Road at the top corner of the Yan Yean water catchment)

Landforms: mountain—sheltered slopes and ridge above 400 m

Canopy: Mountain Grey Gum; with Broad-leaved Peppermint, Messmate, Narrow-leaf Peppermint and Manna Gum; 30–40 m tall and 20–30% cover

4.2. Damp Sclerophyll Forest—sheltered mountain slope

Conservation status: regionally secure

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 80^a, NUH B, 86^b, 88^b, 91^b, 94^a

Distribution: localised in the north sections of NUH and PUH

Landforms: foothill—sheltered hill-slopes and gullies of ephemeral streams down to 250 m elevation

Canopy: Messmate; with Narrow-leaf Peppermint and Manna Gum; occasional Brown Stringybark (e.g. north end of Ninks Road); 30–40 m tall and 30–40% cover

5.2. Riparian Forest—floodplain terrace

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 81^c, 82^d

Degraded, remnant or establishing stands: 82^b

Distribution: localised in NUH along Diamond and Watsons creeks (partially fragmented and degraded)

Landforms: foothill—stream floodplains below 180 m elevation

Canopy: Manna Gum; with Messmate, Mountain Swamp Gum and Narrow-leaf Peppermint; 20–35 m tall and 20–30% cover

5.3. Riparian Forest—creek

Conservation status: regionally depleted

Relatively intact and extensive stands: 81^c, 85^b

Partially intact or small stands: 82^{abcd}, 85^d, PUH C (Bruces Creek downstream of Mill Range Road)

Remnant, degraded or establishing stands: 88^d

Distribution: restricted in NUH and localised in PUH (partially fragmented or degraded)

Landforms: foothill—streams below 300 m elevation

Canopy: Manna Gum; with Messmate, Swamp Gum and Narrow-leaf Peppermint; 25–40 m tall and 20–30% cover

6.1. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally depleted

Reference stands: 80^{bc}, 81^b

Relatively intact and extensive stands: 79^{ab}, 82^b, 83^{bcd}, 84^{ab}, 85^c, 86^{cd}, 87^a, 91^a

Partially intact or small stands: 79^c, 80^a, 81^{cd}, 82^d, 83^a, 85^{bd}, 86^{abe}, 88^{ab}, 93^{ab}

Distribution: widespread in NUH and restricted in PUH where largely cleared

Landforms: foothill—sheltered hill-slopes and valleys (below 250 m)

Canopy: Red Stringybark; with Long-leaf Box, Red Box (NUH) and Narrow-leaf Peppermint (Yellow Box and Candlebark where flanking valley forest); 15–20 m tall and 30–40% cover

6.3. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally secure

Reference stands: 80^{ab}

Relatively intact and extensive stands: 79^{bc}, 85^c, 86^{ab}, 91^{ab}

Partially intact or small stands: 80^c, 81^{ab}, 82^{cd}, 83^{bd}, 84^{ab}, 87^a, 88^b, 93^{ab}, 94^{ab}

Distribution: widespread in NUH and restricted in PUH

Landforms: foothill—sheltered hill-slopes and valleys (below 350 m)

Canopy: Messmate; with Long-leaf Box, Red Stringybark, Swamp Gum, Narrow-leaf Peppermint and Manna Gum; 20–30 m tall and 30–40% cover

8.1. Heathy Forest

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 91^a

Partially intact or small stands: 86^b

Distribution: localised in NUH and PUH to high elevation areas on spurs of the ranges

Landforms: mountain—exposed spurs and slopes (above 350 m)

Canopy: Broad-leaved Peppermint; with Mealy Stringybark, Long-leaf Box, Red Stringybark and Messmate; 10–20 m tall and 20–30% cover

9.1. Heathy Woodland

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 79^b, 85^d, 86^{bd}

Distribution: localised in NUH

Landforms: foothill—exposed hill-slopes and valleys (220–300 m)

Canopy: **Mealy Stringybark**; with Broad-leaved Peppermint, Long-leaf Box, Red Stringybark and Red Box; 8–15 m tall and 10–25% cover

9.2. Heathy Woodland

Conservation status: regionally threatened

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 86^{bd}

Distribution: restricted in NUH to Rankines Road area east of Strathewen

Landforms: foothill—seasonally waterlogged valleys and minor gullies (200–250 m elevation)

Canopy: **Messmate–Green Scentbark**; with Mealy Stringybark and Narrow-leaf Peppermint; 8–20 m tall and 10–30% cover

10.1. Gully Woodland—creek

Conservation status: regionally threatened

Reference stands: 81^b, 84^a

Relatively intact and extensive stands: 86^{abc}

Partially intact or small stands: 82^c, 83^b, 86^d, 86^d, 93^c (Barbers Creek north of Grants Road), 94^b

Distribution: restricted in NUH and PUH

Landforms: foothill—minor streams and sheltered gullies to 250 m elevation; fragmented

Canopy: **Manna Gum**; with Yellow Box, Messmate and Narrow-leaf Peppermint; occasional stands of Yarra Gum (e.g. Bruces Creek); 15–25 m tall and 20–30% cover

10.2. Gully Woodland—sheltered valley/gully

Conservation status: regionally depleted

Reference stands: 80^b, 83^{cd}

Relatively intact and extensive stands: 81^b, 83^b, 84^{ab}, 85^c, 86^{abcd}, 87^a, 91^a

Partially intact or small stands: 79^{ab}, 80^{ac}, 81^{acd}, 82^{bc}, 83^a, 85^a, 88^b, 94^{ab}

Distribution: widespread in NUH and localised in PUH

Landforms: foothill—upper floodplains of perennial streams and ephemeral gullies, minor streams and sheltered valleys to 350 m elevation

Canopy: **Messmate**; with Mountain Swamp Gum (NUH), Mealy Stringybark, Messmate, Swamp Gum, Narrow-leaf Peppermint and Manna Gum; occasional stands of Green Scentbark (*E. fulgens*; e.g. Happy Valley/One Tree Hill); 20–30 m tall and 20–30% cover

10.3. Gully Woodland—sheltered valley

Conservation status: regionally threatened

Reference stands: nil

Relatively intact and extensive stands: 91^c

Partially intact or small stands: 93^{ab}

Distribution: localised in low rainfall sections of PUH (mainly Yan Yean reference area)

Landforms: foothill—drainage lines, minor creeks and sheltered gullies and valleys to 250 m elevation; fragmented

Canopy: Swamp Gum; with Yellow Box, Narrow-leaf Peppermint and Manna Gum; occasional stands of Yarra Gum; 15–25 m tall and 20–30% cover

11.1. Box–Stringybark Woodland—hill-crest

Conservation status: regionally depleted

Reference stands: 80^c

Relatively intact and extensive stands: 79^a, 80^{ab}, 81^{bd}, 84^{ab}

Partially intact or small stands: 81^{ac}, 82^{bd}, 83^{bcd}, 89^a

Distribution: widespread in NUH and localised in the Bannons Road area of PUH A

Landforms: foothill—exposed hill-slopes and hill-crests

Canopy: Red Box–Red Stringybark; with Long-leaf Box; 10–15 m tall and 20–30% cover

11.2. Box–Stringybark Woodland—hill-crest/spur

Conservation status: regionally threatened

Reference stands: 91^{cd}

Partially intact or small stands: 88^b, 91^a, 92^{ab}, 93^b

Remnant, degraded or establishing stands: 89^a, 90^{abc}

Distribution: restricted in Yan Yean reference area and highly fragmented and degraded elsewhere in PUH

Landforms: foothill—exposed hill-slopes and hill-crests

Canopy: Yellow Box–Red Stringybark; with Long-leaf Box; 10–15 m tall and 20–30% cover

11.4. Box–Stringybark Woodland—ridge

Conservation status: regionally depleted

Reference stands: 91^a

Relatively intact and extensive stands: 80^a, 81^a, 83^a, 85^c, 86^{cd}, 87^a, 93^{ab}

Partially intact or small stands: 83^b, 86^{abe}, 88^b, 94^b

Distribution: restricted to sandstone and siltstone sections of NUH (e.g. One Tree Hill summit and St Andrews Wildflower Reserve) and PUH

Landforms: foothill—exposed ridges, hill-crests and hill-slopes from 250–350 m elevation

Canopy: Long-leaf Box–Red Stringybark; with Broad-leaved Peppermint and Messmate; 10–15 m tall and 20–30% cover

Understorey: tall shrubs are sparse and low shrub and field layers are moderately dense (each up to 30% cover) and diverse

14.3. Grassy Woodland—alluvial plain

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: 92^{ab}

Distribution: localised in PUH (Yan Yean Reservoir and Doreen)

Landforms: foothill—plain-slopes and alluvial plains (below 250 m)

Canopy: **River Red Gum**; with Yellow Box; 15–25 m tall and 10–20% cover

14.5. Grassy Woodland—plain-slope

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Distribution: localised in PUH A (Doreen; scattered trees)

Landforms: foothill—plain-slopes (below 250 m)

Canopy: **Blakely's Red Gum**; with River Red Gum, Red Stringybark, Yellow Box and Candlebark; White Box locally extinct; 15–25 m tall and 10–20% cover

14.6. Grassy Woodland—valley

Conservation status: regionally threatened

Reference stands: 91^c

Relatively intact and extensive stands: 81^d

Remnant, degraded or establishing stands: PUH A/C

Distribution: localised in NUH A and formerly restricted in PUH

Landforms: foothill—broad valleys of low elevation (below 220 m)

Canopy: **Yellow Box–Candlebark**; with Long-leaf Box and Red Stringybark; 12–20 m tall and 20–30% cover

14.7. Grassy Woodland—alluvial flat

Conservation status: regionally threatened and disjunct

Reference stands: 91^c; highly degraded and fragmented stands elsewhere

Distribution: localised in PUH

Landforms: foothill—alluvial flats of the Yan Yean reference Area (below 250 m)

Canopy: **Snow Gum**; with Swamp Gum, Candlebark and Yarra Gum; 10–15 m tall and 15–20% cover

25.1. Seasonal Wetland—freshwater meadow/alluvial plain

Conservation status: regionally disjunct

Reference stands: 92^a

Partially intact or small stands: 92^c

Distribution: localised in PUH at Yan Yean Reservoir

Landforms: artificial waterbody; flats around arms of the reservoir in the south-east and north (e.g. Castle Flat)

Character species: **Rush Sedge–Common Spike-sedge**; with Slender Spike-sedge

25.7. Seasonal Wetland—emergent herbfield

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 92^a

Partially intact or small stands: 92^{bc}

Distribution: restricted in NUH and PUH

Landforms: artificial waterbodies; shorelines of dams and reservoirs

Character species: **Common Reed–Cumbungi–Tall Spike-sedge**; with Common Spike-sedge, Floating Pondweed, Water-ribbons and Upright Milfoil

26.1. Permanent Wetland—submerged/floating herbfield

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 92^{abc}

Partially intact or small stands: 87^a

Distribution: restricted in NUH and PUH

Landforms: artificial waterbodies; dams and reservoirs

Character species: **Blunt Pondweed–Lake Eel-grass**; with Pacific Azolla, Common Duckweed

27.1. Swampy Woodland—floodplain

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: PUH C

Distribution: restricted in PUH C where reduced to remnant strata

Landforms: seasonally waterlogged stream and swamp deposits on the floodplain of the Bruces Creek at Upper Plenty

Canopy: **Swamp Gum**; with Blackwood, Yellow Box, Candlebark and Narrow-leaf Peppermint (tree/shrub strata virtually eliminated); 10–15 m tall and 10–20% cover

28.1. Swampy Riparian Woodland—creek

Conservation status: regionally threatened

Reference, relatively intact and extensive or partially intact or small stands: nil

Remnant, degraded or establishing stands: PUH C

Distribution: restricted in PUH C where reduced to remnant strata

Landforms: creek (Bruces Creek at Upper Plenty)

Canopy: **Swamp Gum**; with Black Wattle, Blackwood, Yarra Gum, Woolly Tea-tree and Swamp Paperbark; 12–15 m tall and 10–20% cover

31.1. Valley Forest

Conservation status: regionally depleted

Reference stands: 80^b, 83^{bc}

Relatively intact and extensive stands: 81^b, 83^d, 84^a, 86^c, 87^a, 93^a

Partially intact or small stands: 79^a, 80^{ac}, 81^c, 82^{bc}, 83^a, 84^b, 88^c, 89^a, 90^{bc}, 91^a, 93^b, 94^b

Distribution: widespread in NUH and localised in PUH

Landforms: foothill—sheltered valleys below 250 m elevation

Canopy: Yellow Box–Candlebark; with Blackwood, Long-leaf Box, Red Stringybark, Messmate and Narrow-leaf Peppermint; 15–20 m tall and 25–40% cover

GEOLOGICAL and LANDFORM/SOIL TYPES of the Upland Hills

Silurian Siltstone/Mudstone

Distribution: NUH A (One Tree Hill, associated with the anticline which runs up Happy Valley), NUH B (siltstone along the western margin of the St Andrews anticline at Youngs Road and mudstone east to Black Cameron Road), NUH C (siltstone between Shaws Road and Hewitts Road), PUH A (Bannons Lane)

Landform/Soil Types

Foothill: hill-crests and exposed hill-slopes/shallow, stony brown gradational; sheltered hill-slopes/yellow duplex.

Silurian Sandstone/Shale

Distribution: NUH B (Diamond Creek valley north of Mittons Bridge), NUH C (Rankins Road), PUH A (Nutfield to Doreen and areas to the north), PUH B (Yan Yean Reservoir surrounds), PUH C (Upper Plenty to Wallan East)

Landform/Soil Types

Mountain: spurs, ridges, sheltered slopes/deep yellow gradational; exposed slopes/shallow yellow gradational

Foothill: hill-crests and exposed hill-slopes/shallow stony, brown gradational; sheltered hill-slopes/yellow duplex with shallow sandy loam topsoil.

Silurian micaceous sandstone

Distribution: PUH B (north of Yan Yean Reservoir)

Landform/Soil Types

Foothill: hill-slopes/yellow duplex.

Devonian Volcanic Quartz-diorite

Distribution: NUH B (The Knobs, east of St Andrews)

Landform/Soil Types

Foothill: volcanic plug hill-crest and hill-slopes/yellow duplex and granitic sands.

Devonian Siltstone

Distribution: NUH A (Mt Beggary syncline/Yarra Ridge to One Tree Hill); NUH B (east section from Yow Yow/Wild Dog Creeks to Smiths Gully Creek); NUH C (Arthurs Creek valley north of Strathewen); PUH A (Deep/Running Creeks south along Ridge Road/Stewart Ponds Creek to Yan Yean–Arthurs Creek Road); PUH B (Ridge Road/Coombes Road); PUH C (Upper Plenty and northern section of Eden Hills); the formation enters the northern sections of all biophysical units from the ranges

Landform/Soil Types

Mountain: spurs and upper sheltered slopes/yellow gradational; ridges and exposed slopes/shallow stony, brown gradational; valleys/brown gradational; lower sheltered slopes and saddles/red duplex (areas of impeded drainage)

Foothill: exposed spurs, slopes, hill-crests and ridges/shallow yellow gradational; sheltered hill-slopes/yellow duplex.

Quaternary Colluvium

Distribution: NUH and PUH

Landform/Soil Types

Foothill: broad valley flats and lower hill-slopes/red duplex (peaty-loam topsoil derived from Devonian siltstone in areas of impeded drainage) or yellow duplex with shallow grey loam topsoil (derived from Silurian formations); gullies/yellow gradational.

Quaternary Alluvium

Distribution: NUH A (Watsons Creek and its tributaries); NUH B (Diamond, Smith Gully, Yow Yow, Black Calf/Broad Gully and Wild Dog Creeks); NUH C (Arthurs Creek, Chadds Creek); PUH A (Deep, Running, Stewart Ponds and Doctors Gully Creeks); PUH B (Dry Creek); PUH C (Bruces Creek, Barber Creek)

Landform/Soil Types

Mountain: stream valleys and floodplains/brown gradational loam

Foothill: stream floodplains and flats containing a perched water-table in the Yan Yean Reference Area/yellow duplex (with deep, grey loam topsoil); Yan Yean Reservoir/black uniform clay fringing the reservoir (inlets such as Castle Flat above the northern arm of the reservoir contain high levels of organic peat and silts).

NILLUMBIK UPLAND HILLS (NUH)

Farmland and bushland catchments of the upper Arthurs Creek, Diamond Creek (and tributaries including the Smiths Gully Creek and Yow Yow Creek) and Watsons Creek.

Land-use

Past land-use: pastoral, townships, orchards, firewood and mining. Present land-use: bushland reserves, bushblock and farmlet settlement, townships, orchards and recreation (e.g. St Andrews market grounds and Rob Roy hill climb).

Native vegetation cover

Fragmented west of the Diamond Creek and extensive to the east.

Key biological features

Barking Owl, Powerful Owl, Painted Honeyeater, Brush-tailed Phascogale, Common Dunnart, Common Bent-wing Bat, Eastern Horseshoe Bat and Tree Goanna; valley, riparian and herb-rich foothill (Red Box and Red Stringybark) forests.

Of particular note are the faunal, habitat rarity, abundance and diversity, a foothill forest ecological reference area, and the strategic habitat links between the ranges and lowland hills (primarily the Diamond Creek, Smiths Gully Creek, Watsons Creek and One Tree Hill).

Key areas/physical features for biota

One Tree Hill, Diamond Creek, Watsons Creek, Smiths Gully Creek, Yow Yow Creek and Chadds Creek.

9 sites of significance: 5 state and 4 regional for fauna and 1 very high, 5 high and 3 medium for habitat.

NUH A ONE TREE HILL–WATSONS CREEK UPPER REACHES

This management unit consists of two sites of state faunal significance (sites 80 and 81) and one of regional faunal significance (site 79) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7922 492316 to 7922 539370 (from south to north); 7922 485319 to 7922 561344 (from west to east).

Location/Size: The Watsons Creek catchment lying immediately south of Kinglake National Park. (part of the Watsons Creek Catchment and Yarra Ridge site of Mansergh *et al.* 1989). Approximately 850 ha.

Municipality: Shire of Nillumbik.

Description: The unit contains a contiguous native vegetation link, much of which is public land bordered by a network of uncleared bushland freehold blocks and timbered farmland. Parcels of cleared land owned by Melbourne Water form potential habitat links. The main land-use of the Crown land area has been for gold and timber extraction.

Physical Features

The unit lies in the foothills of the Eastern Uplands at the intersection of the Kinglake Surface. The dominant rock of the Great Dividing Range is from the Devonian period. In the lower foothills to the south, the older Silurian rock has been exposed by erosion. The unit contains the upper reaches of Watsons Creek and its tributaries. It is characterised by steep ridgelines and strongly dissected valleys. The Watsons Creek catchment is provided by two north–south running spurs of the Great Dividing Range. The One Tree Hill ridgeline is contained in the western spur. This has a side spur which runs west from One Tree Hill along One Tree Hill Road and separates the catchment of Smiths Gully Creek/Diamond Creek in the north from Happy Valley Creek/Watsons Creek in the south. The Yarra Ridge forms the eastern spur. This separates the catchments of Watsons Creek and Steels Creek (to the east).

Landforms

Mountain: spurs, slopes, ridges, saddles and creek headwaters, valleys, gullies, stream (second order), creeks and dams. Foothill: ridges, hill-crests, hill-slopes, valleys, gullies, stream (second order), creeks and dams. There is a large gold mine (One Tree Hill Mine) and a small gold mine (Victoria Mine). Elevation is 120–359 m (One Tree Hill).

Hydrology

The management unit contains the ephemeral upper and middle reaches of Watsons Creek and its tributaries (notably the Five Mile Creek, Reedy Creek and Hunchback Creek). In summer the creek remains static for up to several months. At this time it contains a string of shallow pools and intervening dry sections (up to 100 m long). There are large dams in the cleared middle reaches such as along the Reedy Creek on ‘Waneroo’ (a large property owned by Melbourne Water). Smaller dams occur on farmlets and bushblocks. One Tree Hill contains the ephemeral headwaters and upper reaches of four creeks: Happy Valley Creek (south), Five Mile Creek (east), Yow Yow Creek (north) and Smiths Gully Creek (north-west).

The Watsons Creek catchment lies between two rainshadow spurs of the Great Dividing Range. The section of the creek downstream of Reedy Creek was once possibly perennial but the summer flow would have been low. The ratio of water held in the dams over summer to that held in the creek has led to severe ‘dewatering’ of the creek ecosystem. This in combination with an increased land-use intensity in the middle reaches (e.g. septic tank leachate and livestock grazing of creek flats and meadows) in recent decades has led to water salination and pollution.

Rainfall: 680–780 mm.

Site 79 Kinglake National Park Link

- Map Reference:** 7922 602350 (mid-point). One minute lat/long grids include 37° 36' x 145° 18', 37° 36' x 145° 19' and 37° 37' x 145° 19'.
- Location/Size:** Bushland stretching north of One Tree Hill, crossing Butterman Track at Marshalls Road before linking Kinglake National Park. Approximately 400 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Land acquired for the catchment of the proposed Watsons Creek Dam. Public land (uncommitted Crown land block at end of Rifle Range Road managed by NRE and bushland and farmland along the western edge of Waneroo, a beef stud property owned by Melbourne Water. Previously used for timber harvesting (predominantly firewood and some fence posts) and gold mining. Land to the north is national park and to the south forms the One Tree Hill nature conservation reserve. Land to the west is predominantly small bushblocks and mixed livestock farmlets.
- Landforms:** Foothill (see NUH A). Elevation is 180–320 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 1

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Red Box–Red Stringybark box–stringybark woodland (11.1)

FAUNAL SIGNIFICANCE: Site 79 Kinglake National Park Link

Assessment: Regional—Category 1 (B, C, D, E)

Reference grids for the significance keys include:

79^a: 37° 36' x 145° 18'; Rifle Range Road

79^b: 37° 36' x 145° 19'; Waneroo/Butterman Track/Marshalls Road

79^c: 37° 37' x 145° 19'; Roberts Road/One Tree Hill Road

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 79^b: Powerful Owl, Brush-tailed Phascogale, Tree Goanna

Regional. 79^c: Powerful Owl, Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

Local. 79^b: Six species on 15 November 1986 in the vicinity of Marshalls Road and Butterman Track

h. Bats

Regional. 79^b: Six species including the Southern Forest Bat trapped on the fire access track (Roberts Road) along the west side of Waneroo on 26 November 1989

i. Arboreal mammals

Regional. 79^b: Four species including the Brush-tailed Phascogale and Sugar Glider at Marshalls Road on 27 April 1988

j. Ground mammals

Regional. 79^b: Six species including the Brown Antechinus and Bush Rat at Marshalls Road on 27 April 1988

l. Reptiles

Regional. 79^b: Six species including the McCoy's Skink and Delicate Skink recorded at Marshalls Road on 27 April 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 79^b: 100 species

b. Native birds

Regional. 79^b: 62 species

c. Native mammals

Regional. 79^b: 18 species

d. Herpetofauna

Regional. 79^b: 20 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 79^b: 10 species

c. Regionally vulnerable fauna (R2 species)

Regional. 79^b: 4 species. **Birds:** White-throated Nightjar, White-throated Gerygone. **Mammals:** Brush-tailed Phascogale. **Reptiles:** Tree Goanna

Regional. 79^c: 1 species. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 79^b: 2 species. **Mammals:** Mountain Brushtail Possum, Eastern False Pipistrelle

Regional. 79^c: 1 species. **Mammals:** Feathertail Glider

e. Regionally depleted fauna (R4 species)

Regional. 79^b: 4 species. **Birds:** Powerful Owl, Superb Lyrebird, Leaden Flycatcher. **Mammals:** Swamp Rat

Local. 79^c: 1 species. **Birds:** Powerful Owl

f. Regionally restricted fauna (R5 species)

Regional. 79^b: 9 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Striped Marsh Frog

Outlook

The faunal significance will diminish if the link between Rifle Range Track, Marshalls Road and Kinglake National Park becomes further severed by land clearing or housing. This would reduce the ability of fauna to move between Kinglake National Park and One Tree Hill, ultimately lowering the significance of the latter site and further sites along Watsons Creek to Warrandyte State Park. Habitat enhancement to provide a broader connecting link along Five Mile Creek on the western side of Waneroo may improve the rating from Regional to State significance.

FAUNA

Rare or Threatened Fauna

- Bc* **79^b: Powerful Owl.** The range of the breeding pair from One Tree Hill takes in this site and possibly further north into the national park. The north-eastern aspect of One Tree Hill which forms the headwaters of the Five Mile Creek at the rear of Waneroo contains extensive areas of Red Stringybark and Messmate herb-rich foothill forest (6.1 and 6.3) and smaller stands of Messmate–Mountain Swamp Gum gully woodland (10.2). The gullies contain a dense tall shrub strata of Blackwood, Black Wattle and Prickly Tea-tree. The arboreal prey of the Powerful Owl, particularly Common Ringtails, are plentiful.
- Bc* **79^{bc}: Brush-tailed Phascogale.** One was caught in an Elliott trap placed on the ground under Red Stringybark herb-rich foothill forest (6.1) at Marshalls Road. The phascogale has also been seen at One Tree Hill Road (Jeff Johnstone pers. comm.). Based on numbers of sightings and the extent of suitable habitat, One Tree Hill and the southern section of Kinglake National Park is a stronghold of the species in GM (see One Tree Hill site).
- Bc* **79^b: Tree Goanna.** An individual was seen near Butterman Track in the headwaters of Five Mile Creek on 15 November 1986. They enter the site at this time of year and probably constitute wandering individuals from the Mt Beggary area of Kinglake NP. The site appears to be an important link for the species and is probably the dispersal route of vagrants which are occasionally seen at Smiths Gully and in the Bend of Isles area of the Yarra River. The Tree Goanna has declined in range and abundance in NEM. Their survival is critically dependent on the maintenance of functional habitat links. The McCoy's Skink was located under logs on a sheltered easterly aspect under Messmate herb-rich foothill forest (6.3) at Marshalls Road.

Other Significant Fauna

Birds

- Ee* **79^b: Superb Lyrebird—mountain forest link to Kinglake NP at Marshalls Road.** One was recorded south of Butterman Track in Messmate gully woodland (10.2) in the headwaters of Five Mile Creek on Waneroo in June 1986. Individuals disperse into the foothills in the non-breeding season from their breeding grounds in the national park.

Mammals

- Ed* **79^b: Eastern False Pipistrelle and Mountain Brushtail Possum.** A pipistrelle was captured in a bat trap at Marshalls Road on 27 April 1988. This bat is a usual associate of wet and damp mountain forests. This area represents the lowest (300 m) and driest (700 mm) location in which the species was recorded in NEM. The Mountain Brushtail Possum was trapped under Messmate herb-rich foothill forest (6.3) at the rear of Waneroo on 10 February 1992. Similar to the pipistrelle, this location represents the lowest altitude at which the species was recorded in NEM. This highlights the importance of the forest link to the ranges.
- Ee* **79^b: Swamp Rat.** This species was trapped in Messmate–Mountain Swamp Gum gully woodland (10.2) in the upper reaches of Five Mile Creek at the western edge of Waneroo. The trapping site was in a broad valley at the junction of two gullies and contained a sheltered south-eastern aspect. The herbfield contained Sword Tussock-grass, Spiny-headed Mat-rush, Tall Sedge and Variable Sword-sedge, interspersed with thickets of Prickly Tea-tree and abundant fallen logs. Rabbits were abundant and alien weeds including Blackberries were invading.

A Swamp Rat tunnel system had been excavated in the soil and a mosaic of runways was present through the herbfield. Being diurnal, the Swamp Rat requires dense ground cover as a means of protection from predation. Clearing and grazing along Five Mile Creek on Waneroo have greatly depleted the availability of cover. Diggings suggest that Long-nosed Bandicoots may still be present (unconfirmed).

Suitable habitat present for the Common and White-footed Dunnarts. Both species are likely to occur in the site. Extensive trapping was not conducted during the survey. Ground mammal and pitfall trapping should be conducted along the saddle of Marshalls Road near the overlap of Mealy Stringybark heathy woodland (9.1; exposed slopes adjacent to the ridge) and Red Box–Red Stringybark box–stringybark woodland (11.1; ridgetop). This area may provide one of few geographical overlaps of the Common Dunnart and White-footed Dunnart.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Strategic Habitat Link. The Kinglake National Park Link site is a strategic habitat link in North East Melbourne.	
<p>Habitat link fragmentation. Land clearing and increased populations of predators, particularly foxes (but also feral and domestic cats) are the most prevalent threatening processes to the ground fauna.</p> <p>The site provides a strategic link between the One Tree Hill–Watsons Creek Link site, the Diamond Creek Headwaters site, the Watsons Creek–Yarra Ridge site and the Smiths Gully Creek site. Along with the adjacent One Tree Hill site, it forms the most extensive, intact and contiguous foothills link between the ranges and lowland hills in GM.</p> <p>Inadequate width of the Marshalls Road forest link. This important link connecting the Rifle Range block to the Kinglake National Park is too narrow. Weeds have encroached in recent years. Butterman Track, several houses and the gas and fuel high pressure pipeline lie over it. Bushland on the north-west corner of Butterman Track and Marshalls Road was cleared in 1989. This is now regenerating.</p>	<p>Strengthen strategic habitat link. An effective plan must be devised to link forest habitat between Kinglake and the Yarra and prevent further fragmentation. The vital role the site provides as a habitat link requires that it be protected. Revegetation of strategic sections of farmland on Waneroo to provide a fuller link with Kinglake National Park is a high priority.</p> <p>The Marshalls Road forest link between the Rifle Range block and Kinglake National Park contains an overlap of rare woodland and forest habitats. The Mealy Stringybark heathy woodland and Red Box box–stringybark woodland are both inadequately reserved in NEM (and Victoria). A brief survey already found this link to contain rare mammal and reptile species. Several others including the Common Dunnart may prove to be present. Appropriate conservation management of the private land areas of the link and bushland and open space owned by Melbourne Water adjoining the eastern boundary of the link is viewed as a key recommendation of the study</p> <p>Incorporation of Melbourne Water land, particularly the streamway of Five Mile Creek, into the nature conservation reserve. Bushland owned by Melbourne Water shown as occurring in the site (west side of Waneroo along Five Mile Creek) should be incorporated into the proposed reserve. The management of Swamp Rats would be assisted by fencing Five Mile Creek on Waneroo from livestock and by creating additional habitat through replanting severed links to Kinglake NP.</p>

A strip along the creek traversing the Blackberry and other riparian and pasture weeds should be replaced with indigenous species and feral predator (fox) and vermin (rabbits and Black Rat) control would be required if the Swamp Rat colony is to expand. By restoring a broad link, the harmful dieback effect caused by Bell Miners would be curtailed as beneficial foliage insectivores re-established. This link may enable the Superb Lyrebird to once again enter the lowlands of NEM via One Tree Hill and Watsons Creek. A fence along the side of Five Mile Creek would permit regeneration and replanting to enhance the riparian habitat link.

Conservation and land management on private land blocks. Bushblocks along Smiths Gully Road, Rifle Range Road, Marshalls Road and Butterman Track are a critical component of the habitat link at its narrowest point. Blocks within the site of significance containing substantially intact ground flora should be protected from livestock grazing. The land management of these properties should be compatible with management in the proposed reserve. Some of the problems in the proposed nature conservation reserve (e.g. trail bike access and firewood removal) stem from adjoining freehold blocks.

Public access to the Mt Everard section of Kinglake NP from this side, management of the perimeter buffer (e.g. for fire) and predator control are already problems for park management, especially with the present shortfall of staff and resources. The nature conservation reserve and adjacent southern sections of Kinglake NP must receive adequate ranger services and management resources. Over recent years increasing use has been made of the Marshalls Road entry to the NP and this is likely to escalate.

Proposed nature conservation reserve—upgrade land protection and conservation management. The existing uncommitted Crown land (e.g. east end of Rifle Range Road) is a proposed nature conservation reserve and forms a key part of the Yarra–Kinglake Link (LCC Melbourne Area 2 final recommendations).

Dieback along creeks caused by fragmentation and the Bell Miner. There are cleared sections flanking the Smiths Gully Creek (connecting the Smiths Gully Creek site) and Five Mile Creek (connecting the Watsons Creek–Yarra Ridge site). This has facilitated the spread of Bell Miners. They are concentrated in warm, sheltered pockets along the creek gullies. Severe dieback amongst the Swamp Gums and Narrow-leaf Peppermints caused by psyllid insects was observed in February 1992. Erosion, vermin and weeds have become a problem.

Dieback of Red Stringybarks—possibly Cinnamon Fungus. Patches of Red Stringybark in poorly drained areas show dieback symptoms. These may be caused by the activity of the Cinnamon Fungus (*Phytophthora cinnamomi*).

Sustainable land management practices (the adoption of conservation practices in accordance with land capability and land protection) should be promoted on adjacent farmland. Retention of bushland is the most sustainable practice in steep hill country with skeletal soils. Bushland provides for soil and water conservation by reducing runoff rates and protects streams from siltation. Landowners along the upper reaches of Smiths Gully Creek should be encouraged to broaden and adequately fence the habitat link. This will facilitate land protection and natural regeneration. Blackberries and vermin (particularly foxes) should be contained.

Regional Hydrological Strategy

.Cattle grazing of Five Mile Creek and damming of its tributaries on Waneroo. Bushland flanking the creek and its tributaries has been cleared. Cattle have heavily trampled and eroded the bed and banks of the creek and the dense herbfield required by the Swamp Rat has been removed. The creek water is fouled by the cattle.

Poor land protection management on Waneroo is a chief contributor to the high water turbidity of Watsons Creek. Several large dams are present on Waneroo. These are starving the Five Mile Creek, Reedy Creek and Watsons Creek of water (see Watsons Creek to Christmas Hills site 64)

Conservation covenants and environmental education. Landowners should be encouraged to place conservation covenants on these properties. This would enhance on-site management. The benefits of land protection and conservation works should be actively promoted.

Through effective conservation covenants and implementing habitat and conservation works these blocks would enhance the biological value and effectiveness of the public land links. Combined with revegetation works this will greatly strengthen the habitat link. The significance of the link should determine that land-owners who perform conservation works receive financial and educational incentives. Educational material should describe the biological significance of the area and demonstrate the value of conservation management to farm sustainability.

Other Issues

Rabbits and foxes along Five Mile Creek. The upper forested section of the creek is predominantly regrowth. Extensive damage to the creek banks occurred when the trees were bulldozed several decades ago during the clearing of Waneroo. The uprooted trees and debris left in the gullies created a haven for rabbits and foxes. The area still has a large rabbit population and the creek banks are pitted with warrens from plagues during the 1960s and 1970s. Three foxes were seen on 5 November 1992.

Closure of access tracks. Access tracks such as the continuations of Smiths Gully and Rifle Range Roads and from Butterman Track and One Tree Hill Road will need to be restricted to management vehicles.

Control trail bike and off-road vehicle entry and shooters. Increased surveillance of off-road vehicle activity, shooters and woodcutters is required.

<p>Vehicle disturbance—habitat degradation and rubbish dumping. Disturbance arising from on-road and off-road (e.g. trail bike) vehicles is a major threat. Tracks, erosion and loss of ground cover vegetation has resulted from the bikes, which can enter from Smiths Gully Road, Rifle Range Road and Butterman Track, or adjoining properties. Rubbish dumping has facilitated the spread of Blackberries, Common Blackbirds, foxes and introduced rodents.</p>	<p>Formation of a community land protection and conservation group ('friends' group). This site should be included in the area under management by the Friends of One Tree Hill. This group should undertake conservation management activities and raise the community levels of environmental awareness (see One Tree Hill site)</p>
<p>Firewood removal and shooting. Illegal removal of firewood is a common activity. Ground logs and old hollow trees are lacking in areas accessible to the public. Shooting also occurs.</p>	<p>Native vegetation clearance controls. Native vegetation clearance controls should apply for all private land in the site. All the entailed native bushland is regarded as significant and must be protected.</p>

Site 80 One Tree Hill–Watsons Creek Link

- Map Reference:** 7922 500330 (mid-point of Happy Valley). One minute lat/long grids include 37° 37' x 145° 18', 37° 38' x 145° 17' and 37° 38' x 145° 18'.
- Location/Size:** One Tree Hill, 2.5 km NNW of Christmas Hills. Approximately 520 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Land acquired for the catchment of the proposed Watsons Creek Dam. Public: One Tree Hill Bushland Reserve and land in the south owned by Melbourne Water. Private: previous uses: timber harvesting (firewood and fence posts) and gold mining. Surrounding land: bushblocks and mixed livestock farmlets. To the west is the Rob Roy car club hill-climb block and a beef stud property (Waneroo) owned by Melbourne Water occurs to the north-east.
- Landforms:** Mountain and foothill (see NUH A). There is a large gold mine (One Tree Hill/Swedish Mine). Elevation is 120–359 m.

Natural Heritage Values

Landscape. One Tree Hill is the most intact representative of foothills terrain in NEM. The area south of One Tree Hill Road including Happy Valley is the proposed Foothills Ecological Reference Area.

Scientific and Educational Values

Scientific reference. The mine has been continuously occupied by cave-bats for over 50 years (Stan Bone pers. comm.). Banding/movement studies conducted on the Common Bent-wing Bat population in the 1960s by Ellery Hamilton-Smith are of considerable scientific importance (see Fauna).

HABITAT SIGNIFICANCE

Assessment : Very High—Category 1

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Messmate–Mountain Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Relatively intact and extensive stands: Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Partially intact or small stands: Messmate damp sclerophyll forest (4.2)

Endangered species: Rosella Spider-orchid

Vulnerable species: Wine-lip Spider-orchid

Rare species: *Caladenia* aff. *prolata*, Delicate Beard-orchid, Needle Greenhood, Sharp Greenhood, Bearded Greenhood

Critical assemblages or populations: Foothills Ecological Reference Area and Strategic Habitat Link. Rare or threatened orchids; Red Box–Red Stringybark box–stringybark woodland reference stand of One Tree Hill ridge (most significant and intact stand in GM); high orchid diversity (62 species, the richest orchid flora in NEM); high native species and regionally significant species diversity; gully flora of Happy Valley Creek

FAUNAL SIGNIFICANCE: Site 80 One Tree Hill–Watsons Creek Link

Assessment: State—Category 1 (B, C, D, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

80^a: 37° 37' x 145° 18'; upper Happy Valley/One Tree Hill mine/Smiths Gully Rd

80^b: 37° 38' x 145° 17'; Happy Valley Ck West Branch/Clintons Road/Rob Roy ridge

80^c: 37° 38' x 145° 18'; Happy Valley/One Tree Hill summit/O'Sheas Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 80^a: Red-tailed Black-Cockatoo (winter visitor with sightings in 1987, May and August 1994, May and June 1995)

b. Vulnerable fauna

State. 80^a: Swift Parrot, Eastern Horseshoe Bat (roost of four on 31 August 1988 in One Tree Hill Mine)

c. Rare fauna

State. 80^a: Grey Goshawk, Barking Owl, Powerful Owl, Brush-tailed Phascogale, Common Dunnart, Common Bent-wing Bat, Tree Goanna

Regional. 80^b: Powerful Owl (breeding)

Regional. 80^c: Powerful Owl (breeding), Brush-tailed Phascogale

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

f. Breeding migratory insectivores

State. 80^b: 14 species including the Sacred Kingfisher, Brush Cuckoo, Satin and Leaden Flycatchers, Rufous Fantail, Rose Robin, White-throated Gerygone and Cicadabird at Happy Valley Creek West Branch on 29 October 1989

h. Bats

Regional. 80^a: 6 species including 12 female Common Bent-wing Bats and 1 Gould's Long-eared Bat trapped in upper Happy Valley on 27/28 April 1988

i. Arboreal mammals

Regional. 80^a: 6 species including the Koala, Mountain Brushtail Possum and Feathertail Glider in upper Happy Valley on 30 November 1989

j. Ground mammals

Regional. 80^a: 5 species including the Long-nosed Bandicoot in upper Happy Valley on 18 September 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 80^a: 137 species

b. Native birds

Regional. 80^a: 92 species

c. Native mammals

State. 80^a: 25 species

d. Herpetofauna

Regional. 80^a: 20 species

f. Butterflies

State. 80^b: 32 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 80^a: 29 species

b. Regionally endangered fauna (R1 species)

State. 80^a: 4 species. **Birds:** Grey Goshawk, Red-tailed Black-Cockatoo, Noisy Friarbird. **Mammals:** Eastern Horseshoe Bat

c. Regionally vulnerable fauna (R2 species)

State. 80^a: 9 species. **Birds:** Barking Owl, White-throated Nightjar, Singing Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot, Common Bent-wing Bat. **Reptiles:** Tree Goanna. **Butterflies:** Bright Copper**Regional. 80^b:** 3 species. **Birds:** Cicadabird, White-throated Gerygone. **Butterflies:** Bright Copper**Regional. 80^c:** 2 species. **Birds:** White-throated Nightjar. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 80^a: 7 species. **Birds:** Pink Robin, Spotted Quail-thrush. **Mammals:** Mountain Brushtail Possum, Feathertail Glider, Gould's Long-eared Bat. **Reptiles:** Black Rock Skink, Eastern Small-eyed Snake**Regional. 80^b:** 1 species. **Birds:** Collared Sparrowhawk

e. Regionally depleted fauna (R4 species)

Regional. 80^a: 9 species. **Birds:** Peregrine Falcon, Powerful Owl, Australian King-Parrot, Bassian Thrush, Speckled Warbler. **Reptiles:** White's Skink, Red-bellied Black Snake. **Butterflies:** Spotted Brown, Blue Jewel**Regional. 80^b:** 6 species. **Birds:** Powerful Owl, Leaden Flycatcher, Bassian Thrush. **Butterflies:** Flame Skipper, Spotted Brown, Blue Jewel**Regional. 80^c:** 2 species. **Birds:** Powerful Owl. **Mammals:** Swamp Rat

f. Regionally restricted fauna (R5 species)

Regional. 80^a: 13 species. **Birds:** Painted Button-quail, Brush Bronzewing, Cattle Egret, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Common Long-necked Tortoise, Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet**Regional. 80^b:** 9 species. **Birds:** Brush Cuckoo, Rose Robin, Red-browed Treecreeper. **Mammals:** Koala. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Sword-grass Brown, Dark Purple Azure**Local. 80^c:** 5 species. **Birds:** Brush Bronzewing. **Mammals:** Koala. **Butterflies:** Phigalia Skipper, Bank's Brown, Sword-grass Brown

g. Nesting birds of prey

Regional. 80^a: Wedge-tailed Eagle, Peregrine Falcon.**Regional. 80^{bc}:** Powerful Owl

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 80^c: 6 Brush-tailed Phascogales trapped on 12/13 April 1995 (Rusden mammal survey); this is the highest known population density recorded in GM

State. 80^a: population estimate of 40 adult Common Dunnarts/100 ha; this was extrapolated from an average of one nesting female per 5 ha recorded from an intensive area search of 10 ha on the upper exposed slopes north of One Tree Hill summit on 20 November 1988; this is the highest known population density recorded in GM

g. Rare/restricted colonial fauna

State. 80^a: 930 Common Bent-wing Bats on 28 October 1991 in One Tree Hill Mine; the mine supports the largest population (seven counts between October 1991 and April 1993 ranging between 450 and 930) of the bent-wing bat in GM

h. Other fauna

Regional. 80^a: one of the highest known densities of Tree Dragons in the foothills of NEM

i. Regionally vulnerable fauna (R2 species)

Regional. 80^c: 5 White-throated Nightjars calling from the exposed slopes of Happy Valley on 30 November 1989

Outlook

The highest ranking State significance site in NEM. The faunal significance may decline if disturbance to the cave-bat colony and fox/cat predation on ground mammals and birds increases. Further protection and surveillance of trail-bike and horse-rider access is required (gates have proved successful in stopping cars). Habitat link enhancement between One Tree Hill and Kinglake NP would consolidate the faunal significance.

FAUNA

Rare or Threatened Fauna

Ba 80^a: Red-tailed Black-Cockatoo. This species is endangered in Victoria, with a population estimate of only 500–1000 birds remaining. Their range formerly extended into the Melbourne area, but contracted last century due to clearing and timber cutting of the box–stringybark and casuarina woodlands of central Victoria. Breeding of the south-eastern Australian population of the Red-tailed Black-Cockatoo is now restricted to the Casterton–Edenhope area (300 km west of Melbourne), where the main food is seeds of the Brown Stringybark.

No confirmed reports near Melbourne had been made for 100 years. Over the last decade, birds began visiting the stringybark ranges of One Tree Hill and southern Kinglake NP, probably on an annual basis. The first red-tailed blacks seen were at the east end of Smiths Gully Road in 1987 (Lal Curr pers. comm.). Subsequent sightings have been: two birds in June 1990 south of Bald Spur lookout in Kinglake NP, three birds in June 1993 at Broad Gully in Kinglake NP, three birds in winter 1993 and five birds in late August 1994 at the east end of Smiths Gully Road (Harry and Lal Curr pers. comm.), and two birds flying over the ridge track of One Tree Hill on 29 May 1994 (Diane Silveri pers. comm.).

After another observation of birds flying over One Tree Hill Road in early May 1995 (Diane Silveri pers. comm.), four visits were made by the author over June. The Red-tailed Black-Cockatoo was confirmed on 1 June 1995. This was between One Tree Hill Road and the summit, where a family trio (adult male and female with juvenile) fed in a Red Stringybark in heavy fruit (Long-leaf Box–Red Stringybark box–stringybark woodland; 11.4). The male was of similar size to a Yellow-tailed Black-Cockatoo (the male Glossy Black-Cockatoo which also has a red tail is the size of a Sulphur-crested Cockatoo). The female was speckled with yellow on the head and had yellow bars across the throat. The red-tailed blacks continually uttered single screeches (yellow-tailed blacks have a drawn out two-syllable contact call sparingly uttered in

flight and seldom while feeding). The constant calling had been noted by previous observers in the One Tree Hill area.

These birds took boughs containing the stringybark fruit in one claw, snipped the beaks, and nimbly extracted the seeds with their tongue. The beaks of the fruit had begun opening but the seeds were semi-ripened and still 'milky'. Around mid-morning they flew north over One Tree Hill toward Kinglake NP. The red-tailed black also feeds while on the ground. Birds at Smiths Gully Road in winter 1993 stripped large sheets of bark from the lower trunks of Long-leaf Box, hopping over the debris on the ground after dislodged spiders or insects (Harry Curr pers. comm.). They also hacked (in the manner of the Yellow-tailed Black-Cockatoo) eucalypt saplings and Black Wattles for longicorn grubs at the points where sap breaks out due to recent tunnelling of the beetle larvae.

Over a period of a week in late August 1994, five red-tailed blacks flew over upper Smiths Gully Road each day from the Mt Everard area of Kinglake NP in a direct line toward One Tree Hill (Lal Curr pers. comm.). In character with elsewhere they roost near water, and were observed in Broad Gully Kinglake NP in June 1993 (see site 103).

Red-tailed Black-Cockatoos are wanderers. In northern Australia, they are known to undertake long distance seasonal movements. In the Wimmera, birds disperse from their breeding sites between late summer and late winter in search of alternate food sources. They have been observed to return to the same areas each year (e.g. for ripening Buloke seeds), as a learned behaviour of seasonal food availability. The foothill box-stringybark woodlands of the Central Highlands form part of this annual movement for a small number of birds. These have been seen in NEM from late autumn to late winter, during the seed ripening season of the Red Stringybark.

Bb 80^a: Swift Parrot. A group of six to eight birds was observed in a flowering Long-leaf Box in Red Box-Red Stringybark box-stringybark woodland (11.1) by One Tree Hill Road in March 1991 (Diane Silveri pers. comm.). A small group was also observed near the east end of Smiths Gully Road in April 1996.

Bb 80^a: Eastern Horseshoe Bat at One Tree Hill Mine. This species is vulnerable in Victoria. A small roosting colony of four animals was recorded on 31 August 1988 in One Tree Hill Mine (otherwise known as the Swedish Mine). Only one other roosting site is known in GM (Mt Slide Road Mine in the Steels Creek-Watsons Creek Headwaters, site 104). These are two of the western-most known roosts for the species in Victoria. The range of this bat is largely in the Torresian biogeographic zone (tropical/sub-tropical north) of Australia and until recent years was not known in Victoria outside of East Gippsland.

From a statewide perspective, the specific roosting requirements of the Eastern Horseshoe Bat appear to be the limiting factor in its distribution. Protection of these sites would appear to be the most critical conservation issue (Mansergh *et al.* 1989). The retention of habitat links between roosting sites may also be critical. It would appear that foraging areas and adequate food supply along creek-corridor vegetation near the roosts are essential. Fewer than a half-dozen breeding sites of the horseshoe bat are known in Victoria. These are natural caves in the Buchan-Nowa Nowa-Snowy River gorge district of East Gippsland. On rare occasions, breeding animals have been recorded elsewhere (e.g. a female with juvenile under-wing trapped on the Yow Yow Creek/site 83 near St Andrews in November 1990). Away from the maternal colonies in natural caves, non-breeding Horseshoe Bats roost on the ceiling of old mine-shafts. Unusual among insectivorous bats, they hang upside down and wrap their wings around their body like a fruit-bat.

The Eastern Horseshoe Bats are strongly built and have broad wings. They are slow, undulating fliers with a high degree of manoeuvrability. They forage at low-levels, similar to long-eared bats. A horseshoe bat released just after dusk along the Dry Creek at Upper Plenty hovered over shrub foliage, presumably gleaning or flushing insects. They probably land on shrubs and the ground to glean invertebrates. They specialise on large and slow insects (e.g. beetles and moths) which are dismembered and consumed at special night-roosts (Strahan 1988). The echolocation is emitted through the nostrils and the elaborate noseleaf acts as a direction-finder for outgoing calls and amplifier for incoming calls to the moveable ears.

The two mines known to contain roosting colonies of Eastern Horseshoe Bats in NEM are undergoing cave-ins and increased human visitation. Unless renovated, both are considered insecure and have limited life-span for cave-bats. Access to both roost-sites is from horizontal cross-cut drives of mine-shafts. At Mt Slide Road Mine, the horseshoe bat roosts in a separate, warmer section of the mine to the Common Bent-wing Bat. At One Tree Hill Mine the two species occur in the same section but the horseshoe bat roosts separately. They may move around the roost in search of ambient temperatures as they need to maintain higher body temperatures than Common Bent-wing Bats. The sites chosen often have narrow entrance apertures so as to provide a micro-climate that is warm and humid, undergoing little fluctuations or air movement.

Inside One Tree Hill Mine, the Eastern Horseshoe Bats roost by hanging from the ceiling of the upper working face chamber. This lies above the far inside end of the upper level entrance drive. The upper level drive is 1.4 m wide by 1.8 m high and enters about 250 m into the hill connecting a central vertical shaft at its inner end. The central shaft (winze) connects the lower level of the mine. The ceiling along the inner end of the upper level drive forms the floor of a walkway up to the working face chamber. This has been shored but is undergoing dry rot. The area is becoming unsafe and collapses have recently occurred. A large collapse would block external access to the main roost. The remainder of the drive to the entrance is stable. With the proposed re-opening of the mine, the old shoring of the upper level is to be replaced (see Management).

- Bc* **80^a: Grey Goshawk.** Single birds seen on 30 November 1993 and 22 May 1995 hunting low near house by One Tree Hill Road (Diane Silveri pers. comm.).
- Bc* **80^a: Barking Owl.** One was heard calling in upper Happy Valley on 21 January 1995 (Diane Silveri pers. comm.). They have also been heard in 1996 above Smiths Gully Road near Fox Road. This species is rare statewide due to forest and woodland fragmentation (see Gresswell Forest site). It is still widespread in the sclerophyll forests across the northern foothills of NEM. The reason is that large patches of habitat such as One Tree Hill providing adequate populations of important prey species such as the Sugar Glider and Common Ringtail Possum have been retained. The improvement of habitat links between other extensive areas such as the foothills of Kinglake National Park and along the Yarra River at Bend of Isles would consolidate the long-term viability of the species in NEM.
- Bc* **80^{bc}: Powerful Owl nest-sites in Happy Valley.** The Messmate gully woodland (10.2) and Yellow Box–Candlebark valley forest (31.1) of Happy Valley provide large tree hollows for nesting and substantial prey populations. Close monitoring of the pair has been undertaken for six years. Over this period, they have nested on four occasions, in two locations, usually with two young being reared (Alan Webster pers. comm.). The nest sites require protection from human disturbance from May to November, during the breeding season.

Analysis of regurgitated pellets has revealed that the main prey item is the Common Ringtail Possum. Other arboreal prey include the Sugar Glider. Both species feed in the outer canopy, making them vulnerable to owls. Large sleeping birds such as kookaburras and currawongs are also snatched from the outer branch foliage. Relying on sight, the owls scan for their prey from a high branch. They also hunt while flying through the forest canopy in the twilight of dusk or pre-dawn or on moonlit nights. Ground mammals including Bush Rats and rabbits are also taken from forest clearings.

The range of the One Tree Hill pair would comprise the entire management unit and sections of surrounding areas. Powerful Owls require large trees in secluded areas by a stream or gully for nesting and extensive forested slopes for hunting. Daytime roosts are usually in dense trees such as Blackwood, although during the breeding season the male often sits on a high limb overlooking the nest hollow.

The Powerful Owl was first recorded nesting in Happy Valley in 1986. They defend a breeding territory of the order of 800–1000 ha. Owls call most frequently early in the breeding season (autumn–winter). This maintains pair contact and presumably, affirms territorial boundaries with neighbouring pairs. They are the largest of the Australian owls and the non-breeding home range is of the order of 3–4000 ha (Rod

Cavanagh pers. comm.). Home ranges of this size are required to cater for the estimated annual consumption of 250–300 possums per individual. Around a dozen breeding pairs are known in NEM.

The breeding season commences in late autumn–early winter so that the young are reared during spring when food such as the autumn-breeding Common Ringtail Possum is plentiful. Young are first seen out of the nest in late October. Juveniles disperse in late summer and occasionally enter metropolitan areas of Melbourne.

Clearing and fragmentation of lowland forests and encroaching settlement has probably caused the breeding habitat of the owl to retreat. Breeding pairs are now mainly located along secluded, heavily forested foothill and mountain streams. In eastern Victoria, much of the forest that Powerful Owls inhabit is subject to intensive logging. Similar to the Sooty Owl, dependence on old-growth tree hollows and tree hollow nesting mammals makes them susceptible to forest harvesting operations. Hot summer bushfires also reduce the availability of large tree hollows and prey species. There is a further dependence on large unbroken tracts of forest which support adequate prey populations. Conservation of the Powerful Owl will require the protection of large, mature gully trees within extensive stands of old-growth forest.

Bc **80^a: Tree Goanna.** There were several reports from the 1980s by local residents (e.g. during the 1982/83 drought and one in a wood pile near One Tree Hill Road in 1986; Diane Silveri pers. comm.). The operative habitat link to One Tree Hill from Kinglake NP through the Marshalls Road area (site 79) is critical for the goanna, but it is very rare locally.

Critical Assemblages or Populations

Cf **80^b: High diversity of breeding migratory insectivorous birds.** A 30 minute transect was conducted along Happy Valley Creek West Branch from Rob Roy ridge (car club hill-climb boundary) to the junction with the East Branch on 29 October 1989. Fourteen migratory, insectivorous birds were recorded. Habitats traversed in order of meeting included: Red Box–Red Stringybark box–stringybark woodland (11.1; Rob Roy ridge); Red Stringybark herb-rich foothill forest (6.1; lower sheltered hill-slopes of Rob Roy ridge); Messmate herb-rich foothill forest (6.3; lower sheltered hill-slopes between Mine Shaft Track and West Branch); Messmate gully woodland (10.2; West Branch and banks and upper floodplain of the East/West Branch junction); Yellow Box–Candlebark valley forest (31.1); east side of Happy Valley).

Significant species and their breeding habitat:

- Sacred Kingfisher (10.2; bank of lower West Branch)
- Brush Cuckoo (6.3; laying an egg in Rufous Fantail nest in forest undergrowth)
- Rufous Fantail (6.3; as above plus another pair)
- Satin Flycatcher (10.2; two pair with nests on Mountain Swamp Gum limbs)
- Leaden Flycatcher (6.1; Red Stringybark limb)
- Rose Robin (10.2; Blackwood)
- White-throated Gerygone (31.1; Yellow Box canopy)
- Olive-backed Oriole (6.1; Red Stringybark canopy)
- Cicadabird (6.3; Messmate canopy).

Dc **80^a: High diversity of mammals in upper Happy Valley.** Twenty-five native mammal species have been recorded in upper Happy Valley. Diverse assemblages of bats (10 species), arboreal fauna (7 species) and ground fauna (8 species) are represented. The field and shrub layer vegetation on the sheltered mountain slopes in the vicinity of the mine has rehabilitated from past mining activities. The abundance of fallen logs provides excellent ground mammal habitat. The damp sclerophyll forest above One Tree Hill Mine supports the Long-nosed Bandicoot, Bush Rat and a substantial population of the Brown Antechinus. The bandicoot survives in the district only in bushland that is intact and extensive. Regionally rare arboreal species present include the Feathertail Glider and Mountain Brushtail Possum, the latter being one of few records away from the ranges in NEM.

Df **80^b: High diversity of breeding butterflies—Happy Valley Creek West Branch.** Thirty two native species have been recorded breeding or are presumed to breed in the catchment of the Happy Valley West Branch (**80^b**). Twenty one of these species were also recorded hill-topping at One Tree Hill summit (**80^c**). The most productive areas are the gullies and hill-slopes of the West Branch. Research study data conducted between 1986 and 1988 was kindly provided by Michael Braby. One of the research study sites was One Tree Hill summit (hill-topping species) and the other was Happy Valley Creek West Branch upstream of the East Branch. Additional records for the West Branch were compiled by this author between 1993 and 1996. The area is considered one of the most significant sites for butterflies in Victoria (Michael Braby pers. comm.).

One Tree Hill is the most prominent hill-crest/ridgeline for some distance. Many species (about 25% of the local butterfly fauna) require an open hill-top to perform their courtship flights. The presence of the hill, surrounded by extensive, diverse and intact bushland, accounts for the high butterfly diversity (Michael Braby pers. comm.). A broad representation of the foothills butterfly fauna was recorded including eight species of skippers and six species of browns.

The Tailed Emperor was recorded hill-topping One Tree Hill summit in the 1986–88 study. This species is a rare vagrant. It breeds in exotic Cape Wattle in the bayside suburbs of Melbourne. The nearest natural occurrence is the Snowy River gorge where it breeds on the native Kurrajong.

Significant species

- Donnysa Skipper and Spotted Skipper: latter breeding during the 1986–88 study above the lower West Branch on Thatch Saw-sedge (Messmate–Mountain Swamp Gum gully woodland; 10.2); both recorded feeding in a copse of flowering Prickly Tea-tree near the West Branch in early January 1996
- Flame Skipper: adult female seen in early January 1996 amongst Thatch Saw-sedge (larval food-plant) on the sunny, north-eastern slopes of Rob Roy ridge (Red Stringybark herb-rich foothill forest; 6.1)
- Phigalia Skipper: small numbers hill-topping summit during 1986–88 study; single adults recorded nectar-feeding in flowering Burgan at several locations in November 1995
- Symmomus Skipper: female seen on the terrace of Happy Valley Creek in April 1993, laying eggs amongst Spiny-headed Mat-rush (Messmate–Mountain Swamp Gum gully woodland; 10.2)

- Bank's Brown: a few records hill-topping summit during 1986–88 study; common gully species recorded along the West Branch in April 1993; in NEM the larvae are known to feed on Sword and Grey Tussock-grass and Forest Wire-grass
- Cyril's Brown: upland species, common along the ridges and summit of One Tree Hill in spring; in NEM the larvae are known to feed on Grey Tussock-grass and Weeping Grass
- Spotted Brown: common gully species; breeding in late January 1996 on Slender Tussock-grass in sunny flats along the West Branch (gully woodland; 10.2); also present in the headwaters of Happy Valley Creek
- Sword-grass Brown: one sighting hill-topping One Tree Hill summit in the 1986–88 study; in this study it was located amongst Red-fruit Saw-sedge (larval food-plant) in Messmate gully woodland (10.2) along the upper West Branch in late January 1996; only observations in NEM outside the ranges
- Bright Copper: uncommon and breeding on Sweet Bursaria in Red Stringybark herb-rich foothill forest (6.1) on the sheltered mid-slopes of Happy Valley in 1986–88 study; adults recorded in Happy Valley headwaters and breeding along the banks of the West Branch in December 1995
- Blue Jewel: hill-topping Mine Shaft Track ridge above the water tank in December 1995 and Rob Roy ridge in January 1996; probably breeds locally on Blackwood or Black Wattle
- Dark Purple Azure: listed locally rare and not recorded breeding in the 1986–88 study; seen only on one occasion in this study, an adult female investigating Creeping Mistletoe (larval food-plant) on the upper slopes of Rob Roy ridge in December 1995

Fb 80^c: Highest known population density of the Brush-tailed Phascogale in GM; Rusden mammal survey, April 1995. Ground trapping was conducted by students of Rusden College during April 1995 on Melbourne Water land south of the west end of O'Sheas Road and in the adjoining section of One Tree Hill Reserve to the west (Bronwyn Johansson pers. comm.). Approximately 1500 trap-nights were set for a return of six Brush-tailed Phascogale (12/13 April), 44 Brown Antechinus, one Swamp Rat under Messmate herb-rich foothill forest (6.3) in the headwaters of a gully on 27 April, and three Black Rat.

The Brush-tailed Phascogale trapping density is high in a Victorian context, indicating the importance of One Tree Hill for the species. The habitats where the phascogale was trapped in Red Stringybark herb-rich foothill forest (6.1) and Red Box–Red Stringybark box–stringybark woodland (11.1), both contained sparse shrub and ground cover. These are considered the principal habitats for the phascogale in Greater Melbourne. There were several other records of the Brush-tailed Phascogale in reference grid **80^a** from residents along Smiths Gully Road (H. & A. Curr pers. comm.) and One Tree Hill Road (Diane Silveri pers. comm.).

Sites in the One Tree Hill management unit and at the Round the Bend Cooperative and Smiths Gully Creek, constitute 20% of all recent sightings of the Brush-tailed Phascogale within Greater Melbourne. This highlights the significance of these dry forest/woodland habitats for the species (Mansergh *et al.* 1989). The phascogale has declined dramatically from areas closer to Melbourne in NEM due to habitat clearing and fragmentation and cat predation.

Other records from the Rusden mammal survey included a run and scats of the Swamp Rat observed by Hans Brunner in a gully north of the west end of O'Sheas Road; a juvenile Koala spotlight in Happy Valley near the gravel pits on 26 April and incidental sightings of the Short-beaked Echidna, Common Wombat, Common Brushtail Possum, Common Ringtail Possum, Sugar Glider, Black Wallaby and Eastern Grey Kangaroo.

Fb 80^a: Highest known population density of the Common Dunnart in GM. Two female Common Dunnarts with pouched young were located in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) on 20 November 1988. This was during an intensive area search of 10 ha on the upper exposed slopes north-west of One Tree Hill summit. The area supported dense tussock grassland dominated by Silvertop Wallaby-grass and Grey Tussock-grass. One nest was under a sheet of iron and the other was

in a grass tussock. Population densities of the Common Dunnart can increase dramatically within two years of fire. Levels of up to six per hectare can temporarily occupy these areas. One Tree Hill would be an excellent control/unburnt site for a pitfall trapping research study.

The preferred habitat of the Common Dunnart in NEM is box-stringybark woodland with moderate cover (30-50%) of grass tussocks and shrubs. These occupy exposed slopes and also contain bare ground, logs and rocks. Males are solitary and mobile. Females are sedentary and occupy a home range of 1–2 ha, often overlapping that of neighbouring animals. The cup-shaped nest of grass and leaves (built by the female) is placed inside hollow logs, under debris such as flat rocks and in grass tussocks. Females normally have two litters of up to 10 young over the August to March breeding season (Strahan 1988).

Unlike the White-footed Dunnart and Brown Antechinus, the male Common Dunnart can sire a successive litter in the same breeding season. This high fecundity enables rapid population increases in the early to mid stages (2–4 years) after fire. They maximise resource utilisation before population expansions of mid to late fire succession species such as the Brown Antechinus. The antechinus prefers denser shrubland and areas of Austral Bracken on sheltered slopes.

Common Dunnarts are nocturnal, terrestrial insectivores. They hunt by active pursuit or pouncing. Hard-bodied dietary fragments of invertebrates have been taken from their nests. These include beetles, cockroaches and crickets. Soft-bodied spiders, worms, moths (and their larvae) and beetle larvae are also consumed (Strahan 1988).

The related White-footed Dunnart occurs nearby in Yellow Box–Candlebark grassy woodland (14.6) at Christmas Hills and Broad-leaved Peppermint heathy forest (8.1) at Steels Creek and damp heath at Broad Gully in Kinglake NP. The ground and shrub layer utilised by this species is closed (more than 50% cover of grasses and shrubs). The range overlap is of scientific interest as there are few areas in Victoria where the two species occur near each other (see Fleming *et al.* 1979).

The Common Dunnart is representative of the Eyrean (inland) biogeographic zone. Populations in NEM constitute the south-eastern limit to their range in Victoria. The White-footed Dunnart has a Bassian (southern and largely coastal) biogeographic zone distribution. Almost 20% of all observations of Common Dunnarts (including several breeding observations and their nest-sites) during the Greater Melbourne study were from the section of the Nillumbik Upland Hills between St Andrews and Christmas Hills. This area is considered of high conservation importance for the species.

Common Dunnarts are threatened by clearing and fragmentation of their main habitat within the timbered foothills of western Victoria. They are rare on farmland due to removal of logs, rocks and native grass cover. Predation from foxes and cats is also a likely threat. The species has a consistently low trapping success rate in cage or Elliott traps. Techniques such as hair tube and predator scat analyses and pitfall line trapping are required to give an accurate estimate of abundance.

Fg **80^a: High population density of the Common Bent-wing Bat at One Tree Hill Mine.** On 28 October 1991 the no. 1 (upper) adit level of One Tree Hill Mine contained in excess of 930 Common Bent-wing Bats. In November 1995 over 1000 were recorded (Lindy Lumsden pers. comm.). The main roost area is the ceiling of the main working face chamber. This population was over double that of the next largest located in Greater Melbourne during the 1986 to 1996 fauna survey. It is the second largest population (to mines at Lake Eildon) in central Victoria.

Despite constant disturbance, several hundred have been irregularly recorded using the no. 3 (lower) adit level (e.g. 200 on 22 October 1989 and 100 on 31 October 1992). Early season populations (e.g. 27 April 1988) in the no. 3 level appear to consist largely of females. One Tree Hill Mine is a traditional Common Bent-wing Bat roost-site and the geographic centre of the population in NEM. It is surrounded by extensive foraging habitat and habitat links radiate to all other important roost-sites (e.g. Steels Creek, St Andrews, Maroondah Aqueduct and Warrandyte).

Banding and migratory movement studies of Common Bent-wing Bats were conducted in the Melbourne area in the early to mid-1960s (Seebeck & Hamilton-Smith 1967). One of the sites was in upper Happy Valley at the no. 3 adit level entrance of One Tree Hill Mine. Local movements between the mine and the Maroondah Aqueduct (see site 62) and long distance migration were found to be occurring. Bats from the One Tree Hill Mine formed part of the East Gippsland maternity population (Seebeck & Hamilton-Smith 1967). Bats in the no. 3 level roosted between 90 and 150 m in, around the junction of the drives to the Swedish Reef and Moonlight Reef, the majority being in the Swedish Reef drive (Stan Bone pers. comm.).

By the early 1940s, exploration in the no. 3 level was confined to the interior section of the Moonlight Reef drive, at the Mystery Reef. Bats remained in the Swedish Reef drive during the operations (Stan Bone pers. comm.). An estimated population of 4000 to 5000 was still present near the junction of Swedish and Moonlight Reef drives in the no. 3 level in the mid-1960s (Ellery Hamilton-Smith pers. comm.). The shoring timber was in poor condition. In the late 1960s a collapse at the first junction in the tunnel (about 90 m in) blocked access from the interior to the exterior. A further 10 m of tunnel has collapsed in recent years leaving only the first 80 m open.

With the proposed reopening of One Tree Hill Mine, vital research on the ecology and behaviour of Common Bent-wing Bats will be possible. This may include the environmental parameters enabling colonisation of gold mines by cave-bats, banding studies to learn of long distance migration and local movement patterns and an understanding of the effects of disturbance. This will provide an indication to the levels of protection and management required to sustain roosting cave-bat colonies in mines (e.g. type of gating and degree of renovation required).

The Common Bent-wing Bat was relatively common in NEM during the 1960s. Substantial colonies were known from over 20 mines or aqueduct tunnels. With the collapse or backfilling of old mine-shafts, closure of the Maroondah Aqueduct tunnels, urban encroachment and increased rates of human disturbance, the bent-wing bat has become rare. During the NEM survey, they were recorded roosting at 13 localities. Each was a human-made mine-shaft or tunnel. Six of these contained only one or two bats (probably transient) and several others have since been back-filled or have collapsed. Two of the mines (Mt Slide Road and One Tree Hill) are known to be permanent roosting sites. Possibly up to four of the others are permanent (smaller numbers) but these have not been monitored. The permanent sites are those used by wintering females. The others are used intermittently, particularly as summer roosts by males.

The range of the eastern subspecies of the Common Bent-wing Bat is along the east coast of Australia. Most occurrences in NEM are along timbered valleys and streams and are centred around horizontal drives of mine-shafts and aqueduct tunnels. Common Bent-wing Bats hang in an upright position in communal clusters from the ceiling of the roost. At rest, the wingtips fold back against the inner surface of the wing (hence the common name).

Males and females frequently roost separately. The sites chosen during winter when adult females are present in the population are as cold as possible. This allows body temperature to fall close to that of the surrounding air, to slow body metabolism and induce torpor. This conserves stored reserves of fat at a time of food shortage. In NEM, the most suitable mine-shafts are those with ample air flow created by open adits and operative ventilation shafts. Surface water assists these conditions. Most cave-dwelling bats have a narrow tolerance to fluctuating air temperatures and are therefore vulnerable to environmental and climatic changes.

While active during summer, bent-wing bats keep a higher body temperature. They minimise energy loss or the amount required to become active by roosting in tighter clusters in warmer locations, remaining alert through the day. At this time in the One Tree Hill Mine, some bats (mostly males but also a few first year females) roost closer to the entrance or in warm-air pockets under domes in the upper level drive. These are, however, subjected to disturbance from humans. Few bats frequent these areas during winter.

Maternity colonies in Victoria are situated in limestone caves. Six are known, with the three largest in East Gippsland. The Nargun Cave at Nowa Nowa supports up to 60 000 individuals (Norris *et al.* 1983).

Two other colonies occur in the lower Snowy River gorge. The other three colonies are in south-western Victoria (near Warrnambool and Portland).

From late February to mid-March, breeding females disperse over eastern Victoria and south-eastern New South Wales from the maternity sites to join males at the non-breeding roost-sites, where they spend the next nine months. They return to the maternity caves, often accompanied by first year females, from mid to late November, and breed soon after arrival. Individuals banded at the Nargun Cave near Nowa Nowa and at Naracoorte in the south-east of South Australia (both about 300 km from Melbourne) were recorded in the no. 10 Tunnel of the Maroondah Aqueduct at Healesville in July 1966 (Seebeck & Hamilton-Smith 1967).

Little is known about the movements and other ecological requirements of cave-bats. During studies in NEM conducted by Ellery Hamilton-Smith in the 1960s, it was found that Common Bent-wing Bats moved between the One Tree Hill Mine, the Fourth Hill Mines at Warrandyte, and the Maroondah no. 10 Tunnel. The probability that they move between these sites along stream corridors is supported by the capture of bent-wing bats along Watsons Creek, between One Tree Hill and Warrandyte. The Common Bent-wing Bat has complex movement and feeding patterns while in the non-breeding localities. On dusk departure from roosts, bats disperse rapidly in all directions. They frequently move between roosts within the system of caves (or mine-shafts) of an area. Even when not in breeding migration, individual bats may travel 60 km in a single night.

Common Bent-wing Bats hawk small night-flying insects predominantly over the tree canopy. Flight is rapid and zig-zags in a horizontal plane, broken by shallow dives. Fast and high-flying Swift and Hawk Moths may be important prey as moths form a high proportion of the identifiable insect material retrieved from roost-site dropping (guano) deposits. They also forage for mosquitos and midges in forest openings under the tree canopy and over water.

Roost-sites require protection from human visitation and disturbance, particularly if bats are stirred from torpor during winter, undergoing critical energy losses and possible hibernation mortality before regular emergence in spring. Declining populations or desertion at maternity colonies has been observed (e.g. Mooresford Cave near Buchan) due to visitor disturbance. Without protection of maternity sites, this specialised breeding behaviour makes large sections of the population vulnerable. The long-term effects of pesticides and forest clearing remain unknown.

Other Significant Fauna

Birds

Ec **80^{ac}: White-throated Nightjar.** The presence of breeding populations of the migratory, ground-dwelling White-throated Nightjar is significant. This species has been virtually eliminated from small box-stringybark woodland remnants nearer settlement (e.g. Dunmoochin site) throughout the foothills of NEM. Habitat fragmentation associated with clearing and livestock grazing and predation from foxes and cats are likely major contributing factors to this decline. Given appropriate management the population at One Tree Hill is considered the largest and possibly most viable to remain in the foothills. This is due both to the extent and intactness of the Red Box-Red Stringybark box-stringybark woodland (11.1) at One Tree Hill and the sparsely settled nature of the immediate farmland.

Ec **80^a: Singing Honeyeater.** A pair was present in a house garden (feeding in grevilleas) at the east end of Smiths Gully Road from the end of September to early November 1995 and again for two weeks in January 1996 (Lal Curr pers. comm.). Late summer-autumn dispersal from coastal breeding areas into shrublands on the volcanic plains occurs to the north and west of Melbourne (e.g. Craigieburn Grassland on 4 February 1992). Spring-summer sightings in foothill forest are unprecedented in GM. The irregularity of the record made the sighting questionable. After interviewing the observer, who provided details of the facial description and musical voice which discounted the Yellow-faced Honeyeater, the record was accepted. This constitutes only the second sighting in NEM.

Eg **80^a: Nesting Wedge-tailed Eagle.** The eagles nested in a giant Messmate (10.2) in upper Happy Valley in spring 1985. One of the pair was shot during the breeding season of 1985. Since about 1989, a pair have nested in a Yellow Box on a hill-slope near Watsons Creek township (site 64). Birds (possibly this pair) have been frequently observed hunting in Happy Valley between 1993 and 1996. With the increased protection provided by gating of access points into the reserve, nesting may resume in the future.

Ed **80^a: Breeding Spotted Quail-thrush.** The habitat link to areas of upland forest in Kinglake NP is important to the seasonal movements of several ground-dwelling birds such as the Spotted Quail-thrush and Bassian Thrush. Both species breed at One Tree Hill. Non-breeding birds from the ranges also move into the site between late autumn and early spring, where they frequent the exposed hill-slopes. The Spotted Quail-thrush was recorded breeding in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) on 22 October 1989 on the grassy, exposed mountain slopes north-west of One Tree Hill summit. Happy Valley and the Willis Nature Reserve at Smiths Gully (site 83) are two, of few recent breeding localities of the quail-thrush away from the ranges in NEM. Conservation of the habitat link between these two areas along Smiths Gully Creek may be critical for the species to remain breeding in the foothills.

Ee **80^a: Breeding Bassian Thrush.** A pair was recorded breeding in a Rough Tree-fern in Messmate gully woodland (10.2) along Happy Valley Creek East Branch immediately below the No. 3 adit entrance of One Tree Hill Mine on 18 September 1989.

80^a: Damp mountain forest birds in upper Happy Valley—mountain habitat link. Several damp forest species occur in the site that utilise the Messmate gully woodland (10.2) streamway habitat link to Watsons Creek (which then connects higher rainfall areas in Kinglake NP). The links are important in maintaining genetic exchange between otherwise isolated populations. They also facilitate seasonal or migratory movements, juvenile dispersal and local expansions of foraging range of higher altitude species into lower elevations in the autumn-winter.

The damp forest species include the Brush Bronzewing, Powerful Owl, Yellow-tailed Black-Cockatoo, Australian King-Parrot, Brush Cuckoo, Rose Robin, Olive Whistler, Crescent Honeyeater and Red-browed Treecreeper. The Rose Robin, Olive Whistler and Crescent Honeyeater were recorded breeding in upper Happy Valley in September 1989. The Pink Robin breeds in the ranges. During winter it is often seen in stands of Silver Wattle along Watsons Creek (site 64).

Mammals

80^a: Koala. Animals have been observed moving through the bushland at the end of Smiths Gully Road (H. & A. Curr pers. comm.). There does not appear to be a resident population in the One Tree Hill site or sites along Watsons Creek. Resident populations are present along the Yarra near Warrandyte township, along the Smiths Gully and Yow Yow creeks and along Jehosaphat Creek in the foothills of the Kinglake Ranges. Watsons Creek and One Tree Hill form the most direct and contiguous forest link between these areas. The regularity of sightings in the Kinglake National Park Link and One Tree Hill sites indicates they are important dispersal routes for Koalas. These sites provide the most contiguous overland habitat link between the ranges and the Yarra in NEM.

MANAGEMENT

Threatening Processes	Conservation Measures
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 Regional Habitat Link Strategy

Strategic Habitat Link. The One Tree Hill–Watsons Creek Link site is a strategic habitat link in North East Melbourne.

The site has Strategic Habitat Links to the Kinglake NP Link site and Watsons Creek to Christmas Hills site. There is a partial link to the Smiths Gully Creek site. This site completes the most extensive, intact and contiguous habitat link between the ranges and lowland hills in NEM. Sites in the One Tree Hill management unit, with those along Watsons Creek, are considered the critical nodes in the habitat link between the Kinglake Ranges and the Yarra (Warrandyte State Park).

One Tree Hill provides the main overland link and Watsons Creek provides the main riparian link. Together they play a considerable role in the movement of fauna between the Kinglake Ranges and the Yarra Lowland Hills and Alluvial Plains.

The site is critical for connectivity of the Common Bent-wing Bat and the damp forest fauna (particularly mammals and birds) between the ranges and the lowlands. The primary conservation management priority in the Regional Habitat Link Strategy for the Shire of Nillumbik is the full re-establishment and functioning of these links.

Habitat link fragmentation and placental predators. The processes most threatening to the ground fauna are fragmentation of habitat links by land clearing and increased populations of predators, particularly foxes but also feral and domestic (possibly dumped) cats. Particularly threatened are the Common Dunnart, Long-nosed Bandicoot, White-throated Nightjar and small arboreal mammals such as the Brush-tailed Phascogale.

Some of the major issues to be addressed include coordinated weed control, predator control (particularly straying domestic and dumped cats), rubbish removal, tree planting in adjacent habitat links and trail-bike/horse-rider surveillance. Both the main Yarra to Kinglake horse trail and horse-rider transgressions into One Tree Hill Reserve conflict with the aims of designating the site as an Ecological Reference Area.

Strengthen strategic habitat link. An effective plan must be devised for linking forest habitat between Kinglake and the Yarra and preventing further fragmentation. The integrity of the large stands of herb-rich foothill forest and box–stringybark woodland must be preserved.

Conservation link management. Linking One Tree Hill with Warrandyte would facilitate expansion of the activities of the Friends of Warrandyte State Park group. The fragility and biological significance of One Tree Hill/Happy Valley require that access tracks remain closed to vehicles (except for emergency and management) and horse-riders and that only passive public uses such as bushwalking, scientific research and nature education and interpretation activities should be allowed.

Conflicts include weed invasion, track erosion and potential for transgressions off tracks into bushland. Unless the trail can be safely and effectively confined to an existing road (e.g. One Tree Hill Road), it must not encroach or impact upon bushland designated within the ERA. Horse-rider transgressions are already a major problem in Happy Valley. Most of the riders enter from the Clintons Road/Rob Roy area and One Tree Hill Road. Several trails come down the spurs and cross the West Branch into Happy Valley. This is damaging the highly significant West Branch gully vegetation. Many of the woody weeds (e.g. Gorse, Boneseed, Sweet Pittosporum and Montpellier Broom) are controllable but will require immediate action. Bulbil *Watsonia* could also be readily removed. Removing the Blackberry could cause slumping of the banks of Happy Valley Creek and will require a careful approach.

Special Conservation Measures

Foothills Ecological Reference Area. Foothills vegetation is poorly represented in the Reference Area system of Victoria (see chapter 9 of volume 1 for details of this system). The designation of Crown land at One Tree Hill and Happy Valley as the Foothills Ecological Reference Area is one of three principal recommendations of the study (for others see Merri Creek: Craigieburn Grassland and O’Herns Road Wetlands and Plenty Gorge: Plenty–Janefield and Yarrambat–Morang Wetlands). The foothills herb-rich foothill forest and box–stringybark woodland flora and fauna of One Tree Hill would be best conserved in a scientific reference area. Each of the sub-communities within the herb-rich foothill forest, gully woodland and box–stringybark woodland communities in lower Happy Valley is listed as depleted in Greater Melbourne (GM). The site contains the most extensive and intact stands of these sub-communities in NEM. .

One Tree Hill/Happy Valley also contains mountain forest habitat (damp sclerophyll forest). It has the highest ranking habitat values and one of the highest ranking faunal values (particularly mammals) in the upland hills of NEM. It contains one of the most significant, diverse and representative assemblages known of the foothills orchid flora in GM. Cave-bat, orchid and Powerful Owl monitoring programs are in progress. The biotic and landscape system represented at One Tree Hill is threatened statewide. In this context, it is the most fundamentally significant tract of public land in NEM.

Amendment of supporting criteria (see chapter 9 volume 1) for reference area. All foothills ecosystems in Greater Melbourne are fragmented by clearing, degraded by land-use and subjected to widespread threatening processes related to human disturbance. One Tree Hill, like foothills forest throughout Victoria, fails to meet two supporting criteria for reference areas: the requirements of extensive public land buffers and minimal management. Any reference area within this ecosystem would require active conservation management since in the plains and foothills ecosystems the degree of land settlement, as well as land-use, has been more severe than in the mountain forest ecosystems.

The required buffers at One Tree Hill would be, in part, private land, which would require legislative controls to protect the native flora and fauna and promote conservation activities. Natural rehabilitation of disturbed sections such as the Happy Valley gravel pits would best proceed if One Tree Hill is established as an Ecological Reference Area. The inclusion of adjoining bushland presently owned by Melbourne Water into the ERA buffer zone within the biological reserve is a critical requirement in meeting the reference area criteria.

Other Issues

Flora and fauna reserve. The site is a proposed flora and fauna reserve (LCC Melbourne Area 2). The Foothills Ecological Reference Area is included in the biological reserve. The reserve has specific management requirements regarding cave-bats, orchids and public access. Public interpretation and awareness exercises will be required. The reserve must be fully resourced. Inadequate management and ranger services in tandem with the negative image of the area by a small section of the community (e.g. rubbish dumping), needs to be overcome.

Increased ranger services and closure of access tracks. One Tree Hill is undergoing an escalating rate of visitor usage. The traditional problem surrounding One Tree Hill was its image as a Crown land bushblock. Sections of the public perceived this as an unlicensed opportunity to abuse the area. As a nature conservation reserve, more visitors are attracted to the area who appreciate and respect its environmental values. Respect attracts interest and involvement (see formation of the friends group).

Ranger services from Warrandyte SP were extended to One Tree Hill in 1993. Visitation will undoubtedly increase once the reopening of One Tree Hill Mine is made known. NRE ranger services will need to be increased. Essential projects undertaken to date by ranger crews include the coordination of priority tasks outlined in the Interim Management Plan. This has involved close liaison with Friends of One Tree Hill activities including tree planting, erosion control, weed control (particularly blackberry and pittosporum) and rubbish removal (see next section).

Other tasks have included the picnic area, car park and footbridge works on Watsons Creek and site rehabilitation of the junction of Happy Valley Creek with Watsons Creek (site 64), gating/fencing and signage of entrances to One Tree Hill Reserve (top and bottom of Happy Valley Track and the top of O'Sheas Road and Summit Track), contour ripping and closure of internal trail-bike and 4WD tracks and monitoring of rare or threatened plants and animals including fencing of research areas.

Vehicle incursions. Trail-bikes entering from Clintons Road still frequent the Rob Roy ridge. Locked gates appear to have stopped the cars. Prior to the gates, vehicle access was provided by the Summit Track, Happy Valley Track and O'Sheas Road. 4WD tracks ran up the gullies on the east side of Happy Valley. The car and trail-bike activity was very severe around the old gravel pits area.

The trail-bikes have left numerous tracks above the gravel-pits on the steep, exposed hill-slopes of One Tree Hill. Erosion and loss of ground cover vegetation resulted. Runoff after heavy rains contributes to the high water turbidity of Watsons Creek.

The advance of Large Quaking-grass and Sweet Vernal-grass from the tracks is a threat to the Rosella Spider-orchid. The exposed slopes are breeding areas of the White-throated Nightjar. This species is already threatened by predators including the fox and cat. Until disturbance from trail-bikes is eliminated, it remains locally endangered.

Formation of the Friends of One Tree Hill (FOOTH). 1996 is the fourth year of operation for FOOTH. It has been supported by ranger staff from Warrandyte SP and grants from Melbourne Parks and Waterways. The management challenge presented by Happy Valley/One Tree Hill would be difficult without this continued support. The ranger staff provide structural foundation and skills (e.g. fencing) while grants provide material resources. FOOTH provides the workforce. Essential projects undertaken to date by FOOTH include tree planting, erosion control (Happy Valley gravel pits area), weed removal (e.g. Sweet Pittosporum from the upper section of the Happy Valley Creek West Branch and Sweet Vernal-grass from track sides), rubbish removal, fencing, plant propagation and the installation of nest boxes for the Brush-tailed Phascogale.

The work of FOOTH and rangers from Warrandyte SP has enabled a successful land-use transition from uncommitted Crown land to Nature Conservation Reserve. One Tree Hill has become the finest scientific research study site in NEM. It is also an excellent nature interpretation area, as evidenced by the attendance of nature walks organised by FOOTH.

Native vegetation clearance and grazing controls over significant private bushland. Restrictions on clearing of native bushland on private property in the site (particularly along the contiguous northward link connecting Kinglake NP) is essential (e.g. the retention of flight corridors and foraging areas for cave-bats). The livestock grazing issue needs to be fully addressed by the Shire of Nillumbik.

Weeds. These have caused population declines or elimination of native species of flora and fauna. Blackberry and Montpellier Broom occur along Happy Valley Creek. Small areas of Bulbil Watsonia, Spanish Heath and Gorse occur below the Happy Valley gravel pits. Sweet Vernal-grass and Sweet Pittosporum have taken over disturbed sections of the sheltered slopes and gullies. Large Quaking-grass has spread from tracks onto the exposed slopes. Localised areas of Boneseed are establishing on the lower sheltered slopes.

Little Watsons Creek Reservoir proposal. Much of lower Happy Valley would be inundated by the proposed dam. This would eliminate significant flora species and fauna habitat including the Powerful Owl nesting area and the section occupied by Long-nosed Bandicoots.

A discussion as to the effects of the dam is made in Watsons Creek to Christmas Hills site (64).

Habitat degradation from gravel mining. The activity of trail bikes and 4WD cars in Happy Valley restricted the rate of rehabilitation of the slopes above the gravel pits and of old surface mining operations along the creek. Erosion, blackberries and alien grasses have advanced from the tracks and the creek. Other disturbances from earth moving activities periodically occurred (training area for CFA truck and shire grader drivers etc.). This caused further erosion and spread of weeds.

Melbourne Water land consolidation and/or rezoning. Adjoining land owned by Melbourne Water in the Little Watsons Creek Reservoir catchment containing intact or extensive bushland should be conserved. Any Melbourne Water land earmarked for disposal in the site containing significant habitat or with high potential as a habitat link should be placed in public ownership and managed for nature conservation. Any disposal of land by Melbourne Water which holds regional or higher fauna or habitat significance (this should be a condition for the disposal of any public land in NEM) should be accompanied by an Environmental Impact Assessment which clearly addresses the impact of this action on the fauna and faunal habitat values. This should also address the steps to be taken to maintain these values.

Require improved management of other fragmented areas of public land in the district.

These form part of a strategic habitat link network connecting One Tree Hill. Key areas to the west of the site include Boomers Reserve (site 77), Long Gully Creek (site 78) and Smiths Gully Creek (site 83). These areas require improved protection and enhancement of indigenous flora and fauna.

Conservation covenants. The placement of covenants with specific, conditional and pro-active clauses regarding the protection of fauna and faunal habitat values should be encouraged on surrounding private land. The purpose and benefits of covenanting should be promoted to all landowners within or adjoining the site.

The Victoria Mine has become dangerous and should not be entered. The Victoria Mine is prone to collapsing. Several internal collapses have blocked ventilation shafts and narrowed the aperture of the horizontal drive near its entrance. This has caused pockets of 'dead air' to develop. Vertical shafts near houses along One Tree Hill Road have been back-filled.

Firewood and tree-fern removal, shooting and rubbish dumping. Until the erection of gates, illegal removal of firewood was a common activity. Ground logs and old hollow trees are lacking in areas accessible to the public. Rough Tree-ferns were removed from upper Happy Valley in the 1980s. Shooting frequently occurred in Happy Valley. One of the pair of Wedge-tailed Eagles was shot during the breeding season of 1985. Access into the site created these problems. Firewood removal and rubbish dumping still occurs along One Tree Hill Road

Past car dumping and stripping. This activity has ceased since the construction of gates to entry tracks. The cars were often dumped in Happy Valley Creek. The disturbance and debris has facilitated the spread of Blackberries, Common Blackbirds, foxes and introduced rodents. Car bodies were removed during 1991 in a combined operation between the Army and the then Shire of Eltham.

Management of the One Tree Hill Mine and Surrounding Area

The threat: Disturbance to cave-bat colonies in the One Tree Hill Mine

The no. 3 adit level is one of the most well known and visited mines near Melbourne. The presence of the bat colony is also widely known. There are disturbing reports that bats have been removed or interfered with. Publicity about the mine reopening will attract further human visitors. The shoring timber in the no. 3 adit level is unstable and cave-ins have recently occurred near the end. Human visitation presents a risk to the roosting bat colony and further cave-ins, with the real risk of a fatality. If visiting is to continue, it will cause the bats to cease roosting in this level.

The drive of the no. 1 adit level is also visited by humans. In recent years the number of bats roosting in this drive has declined. The walkway up to the roosting chamber entrance is considered unsafe for human passage. Recent collapse of the ventilation shaft (leading off to the right from the end of the no. 1 adit level) is a concern to the long-term occupation of the level by bats. Continued disturbance from human visitation near the roosting colony could cause roost desertion by part or potentially all of the population (as happened at Geraughtys Mine at Fourth Hill in Warrandyte SP and many other mines elsewhere in NEM).

The management plans

One Tree Hill Mine reopening. The LCC Melbourne Area 2 report recommended that applications for mineral exploration be permitted at One Tree Hill. The status and ecological requirements of the cave-bats and the condition of the mine regarding its viability as long-term cave-bat habitat was ascertained. The granting of the extraction lease is conditional on the licensee providing a Works Plan with exacting safeguards for conserving flora and fauna, including cave-bats. After extensive consultation with the licensee, and subject to an acceptable Works Plan, a proposal to re-open the no. 3 adit of One Tree Hill Mine has been endorsed by scientists and NRE on the grounds of cave-bat conservation.

The most important issue the Works Plan needs to address is the environmental impact on flora and fauna in the area surrounding the mine. Any deviation from the Works Plan requires approval of the Ranger in Charge. Ongoing liaison with NRE officers is required. Schedules have been drawn up under the Mineral Resources Development Act on the terms and conditions for protection of cave-bats and flora and fauna.

The conditions, which will enable research into the ecological requirements of cave-bats, are expected to provide adequate protection for the bats while permitting orderly working of the mine.

- The licensee shall restore the timber shoring in the no. 1 adit and provide a barrier between bats in this area and the works area in level 3.
- Scientists shall monitor the effects of the works and any adverse impacts on the cave-bats.
- Measures are to be taken by the licensee to ameliorate any such impacts. This includes suspending works at the request of the Director, National Parks Service until changes are put in place to ensure protection of the cave-bats.

Safeguards to minimise the disturbance impact of mining activities on other relevant or significant flora and fauna values of the site (e.g. heavy truck disturbance of the nesting Powerful Owls) have been addressed.

- The conditions require the protection of all vegetation and habitat beyond the designated mining operation compound (surrounding the no. 3 adit entrance).
- All ore shall be transported off-site for crushing and processing.
- Mullock disposal shall be restricted to the gully within the compound area.

Habitat rehabilitation outside the One Tree Hill Mine. Since mining operations were abandoned the sheltered slopes at the north end of Happy Valley near the One Tree Hill Mine have revegetated and recovered more fully than areas at most operations nearer settlement in NEM (e.g. Panton Hill), the size and unfragmented nature of the bushland and relative remoteness from continual sources of disturbance being contributing factors. With the proposed reopening of One Tree Hill Mine, vigilant rehabilitation will be required. A Rehabilitation Plan is to be provided by the licensee. This requires weed control, rehabilitation and revegetation of the works and compound areas (including the mullock) and access track in accordance with NRE standards for conservation reserves.

Mining exclusion beyond the current permit to reopen One Tree Hill Mine. The reopening of One Tree Hill Mine is being considered under exceptional circumstances (e.g. benefit to cave-bat conservation). No other leases for mining elsewhere at One Tree Hill should be granted. Strong objections on the grounds of flora and fauna conservation would be raised from scientists and the community.

Renewed disturbances from earthmoving activities are likely to lead to environmental degradation. This would be totally inconsistent in the context of the biological significance of the site, the damage inflicted and stage of recovery since past mining and other disturbances and the importance of the site as a viable habitat link. Watsons Creek below Happy Valley Creek (site 64) is of considerable significance for native fish and the Platypus. Declining water quality entering Watsons Creek from Happy Valley Creek as a result of turbid runoff or contamination from mining activities could threaten these populations.

Installation of fenced compound at the no. 1 adit entrance and management to protect the cave-bat roost. Cave-bats have a narrow tolerance to human disturbance at roost-sites. The installation of a locked compound around the outside of the no. 1 (upper) adit level entrance is the preferred option. A trial gate inside the adit was installed by the landowner. The design (bars of angled iron) was found to obstruct the passage of Common Bent-wing Bats. An improved design with round bars may be sufficient. Bats would resume roosting in the drive of this level if it were properly gated.

In the proposed reopening of the mine there is a plan to install a gate inside the no. 3 level entrance (see above). After mining operations finish, it is likely that larger numbers of Common Bent-wing Bats would occupy the no. 3 level as this appears to be a traditional roost site. With both entrances gated and locked there is potential for several thousand bats to occupy the mine. This would be one of the largest non-maternity populations and possibly the largest population utilising artificial habitat known in Victoria.

There is a need for active management of the mine regarding the conservation of the Common Bent-wing Bat. The overall population of these bats in Victoria may be declining (Ellery Hamilton-Smith pers. comm.). A more secure and substantial population at One Tree Hill is important for the conservation of the species in Victoria. This is addressed within the mining proposal, which includes the re-shoring of unstable sections of the no.1 level and reopening of the collapsed no. 3 level. The latter exercise may well restore a population in the mine approaching the estimates of the 1960s (4000 to 5000).

The Eastern Horseshoe Bat can become very stressed, vocal and hyperactive in certain situations when approached in mines or when trapped. In the former situation, particularly while breeding, they seldom settle down and usually desert the roost. For this reason, if the mine is reopened, connections between the upper and lower sections will be closed off by a barricade. It will be critical that the upper section remains undisturbed. Experimentation with a bat grill inside the entrance of the no.1 level has shown that it interferes with the flight/echolocation of Common Bat-wing Bats. Populations using the mine fell dramatically while the gate was closed. A compound is urgently required at the upper level entrance to prevent human intruders.

Long-term scientific and ecological research into cave-bats. Studies conducted in the 1960s determined the wintering female colony of Common Bent-wing Bats at One Tree Hill to belong to the east Gippsland maternity population (Seebeck & Hamilton-Smith 1967). Further knowledge of cave-bat ecology has been gained from recent studies at One Tree Hill. Monthly dusk counts of bats leaving the no. 1 adit level entrance were conducted in 1991/92 (Lindy Lumsden pers. comm.). While the study was short-term, monthly and/or seasonal fluctuations in populations were observed. Movement to other mines and aqueduct tunnels in NEM is likely to be occurring. While One Tree Hill Mine is the most important roost-site known in GM, the population appears to require alternative roost-sites. The protection of these sites may be essential to maintain the large population at One Tree Hill. Continued population monitoring and a mark and recapture or telemetry (radio-tracking) study of their local and regional movements is recommended.

Planning Recommendations

Foothills Ecological Reference Area. The public land area of One Tree Hill forms the proposed Foothills Ecological Reference Area (see under Management, above). An ERA buffer zone is provided by surrounding private land and Melbourne Water land. The negotiation of conservation covenants or similar conservation agreements as to the management of adjacent freehold bushland would be desirable.

Designated threatened or depleted landform, habitat, assemblage or species categories in the proposed ERA include:

- One Tree Hill Mine: Common Bent-wing Bat and Eastern Horseshoe Bat.
- Red Box–Red Stringybark and Long-leaf Box–Red Stringybark box–stringybark woodlands: orchid assemblage (particularly the Rosella Spider-orchid, Delicate Beard-orchid, Needle Greenhood and Bearded Greenhood), Barking Owl, White-throated Nightjar, Brush-tailed Phascogale and Common Dunnart.
- Red Stringybark herb-rich foothill forest: orchid assemblage (particularly the Wine-lip and Plain-lip Spider-orchids and *Caladenia* aff. *prolata*).
- Messmate–Mountain Swamp Gum gully woodland: butterfly fauna, rare gully flora and orchid assemblage.
- Messmate herb-rich foothill forest: Powerful Owl/arboreal mammal prey and greenhood orchid assemblage (particularly the Slender Greenhood).
- Yellow Box–Candlebark valley forest: Powerful Owl nest-tress/arboreal mammal prey and migratory insectivores.
- Messmate damp sclerophyll forest: rare ferns, Dark-tip Greenhood and ground mammals (particularly Long-nosed Bandicoot).

Nature Conservation Reserve (refer LCC Melbourne 2 report).

Re-assessment of zoning and use of adjacent land owned by Melbourne Water. Land acquired for but not incorporated in the Little Watsons Creek Reservoir should be rezoned with appropriate considerations

of its biological significance and utility as a habitat link to neighbouring sites (see also Long Gully Link site and Watsons Creek–Yarra Ridge site).

Site 81 Watsons Creek–Yarra Ridge

- Map Reference:** 7922 517317 to 7922 541357 (Watsons Creek); 7922 538337 (mid-point of valley forest/gully woodland census plot). One minute lat/long grids include 37° 36' x 145° 20' to 145° 21', 37° 37' x 145° 20' to 145° 21', 37° 38' x 145° 19' to 145° 21' and 37° 39' x 145° 19' to 145° 20'.
- Location/Size:** Catchments of Watsons Creek along a southern spur (Yarra Ridge) of the Great Dividing Range downstream of Kinglake National Park. Part of the Watsons Creek Catchment and Yarra Ridge site (Mansergh *et al.* 1989). Approximately 1300 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Public Land Water Frontage (K1, LCC 1977). The entire length of the stream in this site is K1. Watsons Creek Dam Reservation (Melbourne Water). This land extends over the proposed catchment of the Watsons Creek Dam (e.g. fronting the large beef stud property (Waneroo) to the north of the creek, between Five Mile Creek and Butterman Track. Private: Planning Zone PPP 18 (lower catchment of the proposed Watsons Creek Dam) and remaining bushland. Some of the bushland has regenerated from previous clearing. Surrounding land near Christmas Hills is predominantly of small bushblocks and mixed livestock farmlets.
- Landforms:** Mountain and foothill (see NUH A). Elevation is 140–330 m (Yarra Ridge).

Scientific and Educational Values

Scientific reference. The section of Watsons Creek 500 m upstream of Butterman Track is the 'control' bird census plot in the valley forest/gully woodland fragmentation study (see Regional Habitat Link Strategy). The plot contained high faunal species density and richness components.

HABITAT SIGNIFICANCE

Assessment: High–Category 2

Reference stands: Red Stringybark herb-rich foothill forest (6.1); Manna Gum gully woodland (10.1)

Relatively intact and extensive stands: Manna Gum (creek) riparian forest (5.3; Christmas Hills to Butterman Track); Messmate gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark grassy woodland (14.6); Yellow Box–Candlebark valley forest (31.1)

Critical assemblages or populations: Strategic Habitat Link upstream of Butterman Track, Watsons Creek supports one of the most intact representatives of herb-rich foothill forest and gully woodland habitats and plant and animal species and assemblages within the upland hills.

FAUNAL SIGNIFICANCE: Site 81 Watsons Creek–Yarra Ridge

Assessment: State–Category 3 (B, C, E); Regional (C, D, E, F)

Reference grids for the significance keys include:

81^a: 37° 36' x 145° 21'; Skyline Road North

81^b: 37° 37' x 145° 20'; Watsons Creek/Reedy Creek upstream of Butterman Track

81^c: 37° 38' x 145° 19'; Watsons Creek, Christmas Hills to Butterman Track

81^d: 37° 39' x 145° 19'; Christmas Hills

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 81^b: Barking Owl, Brush-tailed Phascogale, Common Dunnart, Tree Goanna

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 81^b: 8 species including the Brush Cuckoo, Tree Martin, Rose Robin and Cicadabird on the Watsons Creek bird census plot in October 1989

h. Bats

State. 81^a: 8 species from four trap nights (from 23 April 1988) including the Gould's Long-eared Bat and Eastern False Pipistrelle on the fire access track connecting Skyline Road North and Brennan Avenue (Langs)

i. Arboreal mammals

Regional. 81^b: 5 species including the Koala and Feathertail Glider along Watsons Creek downstream of the Kinglake NP boundary on 26 April 1988

j. Ground mammals

Regional. 81^b: 5 species including the Brown Antechinus and Bush Rat (both trapped) on Watsons Creek downstream of the Kinglake NP boundary on 26 April 1988

k. Frogs

Regional. 81^b: 7 species including the Growling Grass Frog and Striped Marsh Frog in a 20-minute frog count for the Reedy Creek at Butterman Track on 5 December 1988

l. Reptiles

Regional. 81^b: 7 species including the Southern Water Skink, Delicate Skink, McCoy's Skink and Eastern Small-eyed Snake on the bird census plot along Watsons Creek on 3 October 1989

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 81^b: Over 120 species

b. Native birds

Regional. 81^b: Over 80 species

c. Native mammals

Regional. 81^b: 18 species

d. Herpetofauna

Regional. 81^b: 21 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 81^b: 17 species

b. Regionally endangered fauna (R1 species)

Regional. 81^{bd}: 1 species. **Mammals:** White-footed Dunnart

c. Regionally vulnerable fauna (R2 species)

State. 81^b: 8 species. **Birds:** Barking Owl, White-throated Nightjar, Cicadabird, White-throated Gerygone. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Yellow-bellied Glider. **Reptiles:** Tree Goanna

d. Regionally rare fauna (R3 species)

Regional. 81^b: 2 species. **Mammals:** Feathertail Glider. **Reptiles:** Eastern Small-eyed Snake

Regional. 81^a: 2 species. **Mammals:** Gould's Long-eared Bat, Eastern False Pipistrelle

Regional. 81^d: 1 species. **Mammals:** Feathertail Glider

e. Regionally depleted fauna (R4 species)

Regional. 81^b: 6 species. **Birds:** Australian King-Parrot, Superb Lyrebird, Leaden Flycatcher, Eastern Whipbird, Bassian Thrush. **Reptiles:** Red-bellied Black Snake

Regional. 81^d: 2 species. **Birds:** Leaden Flycatcher, White-winged Triller

f. Regionally restricted fauna (R5 species)

Regional. 81^b: 13 species. **Birds:** Painted Button-quail, Brush Bronzewing, Barn Owl, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

Local. 81^d: 3 species. **Birds:** Long-billed Corella. **Frogs:** Striped Marsh Frog

g. Nesting birds of prey/parrots

Regional. 81^b: Australian King-Parrot (Manna Gum hollow along Watsons Creek)

F. POPULATION DENSITY: Viability and Abundance–point census

i. Bat trapping rate

Regional. 81^a: average of 13 animals per night from four trap nights (from 23 April 1988) on the access track connecting Skyline Road North and Brennan Avenue (Langs)

m. Regionally rare fauna (R3 species)

Regional. 81^a: 5 Eastern False Pipistrelles caught at Skyline Road North on 23 April 1988

Outlook

The faunal significance of the site is stable. Enhancement of the riparian link to downstream sites is considered essential for the viability of downstream faunal populations. The riparian link downstream of Butterman Track is narrow in sections, becoming weed invaded and being taken over by Bell Miners. Mountain Swamp Gums are dying as a result of the miners. The entire streamway (100 m either side of the creek) requires fencing and intensive conservation management. This would improve the riparian ecosystem and water quality of the stream. The proliferation of farm and bush dams needs to be stemmed if the significant instream fauna of the Watsons Creek to Christmas Hills site is to be maintained.

FAUNA

Rare or Threatened Fauna

Bc 81^b: Barking Owl. The substantial Sugar Glider and Common Ringtail Possum populations in the Manna Gum gully woodland (10.1) upstream of Butterman Track is important for this species. During the non-breeding season, the home range of the owl expands into nearby farmland and rabbits become an important prey component. The restoration of riparian and overland habitat links between other extensive forest areas in the Nillumbik Upland Hills and Yarra Lowland Hills would consolidate the long-term viability of the owl in NEM.

Bc 81^b: Brush-tailed Phascogale. A phascogale tail was located on the valley forest/gully woodland census plot on 3 October 1989. The animal may have been taken by the Barking Owl or possibly a cat. The phascogale has declined dramatically in areas closer to Melbourne due to habitat clearing and fragmentation and cat predation.

Bc 81^b: Common Dunnart. An adult male was captured in an Elliott trap under Red Stringybark herb-rich foothill forest (6.1) above Watsons Creek upstream of Butterman Track on 17 October 1989. This was within 500 m of where the White-footed Dunnart was recorded in 1988. The undersides of the feet were

carefully examined. The raised granular pads lacked the lateral striations of the White-footed Dunnart (see *Eb*).

Other Significant Fauna

Birds

Ec **81^b: White-throated Nightjar.** The population upstream of Butterman Track is contiguous with those to the north in the Watsons Creek headwaters and Mt Everard section of Kinglake National Park. These ground birds are vulnerable to predation from foxes and cats, forest clearing and grazing. Their local elimination would further isolate the population at One Tree Hill.

81^b: Habitat link along Watsons Creek for damp mountain forest birds. This link is important in maintaining genetic exchange between otherwise isolated populations. It facilitates seasonal or migratory movements, juvenile dispersal and local expansions of the foraging range of higher altitude species into lower elevations in the autumn–winter. Several damp forest species utilise the Manna Gum gully woodland (10.1) and Red Stringybark/Messmate herb-rich foothill forest (6.1/6.3) corridor along Watsons Creek. This connects higher rainfall areas of Kinglake National Park.

The creek link is crucial for species such as the Superb Lyrebird, Eastern Whipbird, Bassian Thrush and Red-browed Treecreeper. The former three do not breed downstream of Butterman Track and the treecreeper occurs where a more extensive belt of trees persist at the confluence of Five Mile Creek. The riparian corridor is also likely to be important for dispersal of the Common Bent-wing Bat between the One Tree Hill Mine and Mt Slide Road Mine.

Mammals

Eb **81^{bd}: White-footed Dunnart.** The site contains an overlap in range of the White-footed Dunnart and Common Dunnart. There is a museum specimen of a White-footed Dunnart taken from Yellow Box–Candlebark grassy woodland (14.6) near McKinnon Terrace (**81^d**). One was also obtained in March 1988 near Watsons Creek upstream of Butterman Track (**81^b**) by a local resident (Rob Shackleton) and identified by Sandy Gilmore (former research biologist at the Arthur Rylah Institute). The location was within 500 m of where a Common Dunnart was captured on 17 October 1989 (see *Bc*). Some uncertainty arises with identification of both species in this area. The White-footed Dunnart of coastal heath near Western Port is distinguishable from the Common Dunnart by its superior size and contrasting white coloured belly.

A White-footed Dunnart trapped near Mt Slide Road in the Steels Creek–Watsons Creek Headwaters site (104), had the striated foot pads and lighter belly, but was otherwise similar in size to the Common Dunnart. It is possible (though unproven) that when in geographical overlap, the two species interbreed and populations with intermediate characters occur. It is also possible that some inconsistency in the foot pad markings occurs for the Common Dunnart (e.g. become obscured or worn with age), and the trait is not an accurate criteria for identification.

Ec **81^b: Yellow-bellied Glider along Watsons Creek.** One animal responded to a playback tape of the species call just after dusk on 24 October 1990. It was seen at the national park boundary (about 1200 m upstream of Butterman Track) on the trunk of a large Manna Gum (10.1) amongst a stand of large trees at the confluence of a broad tributary valley. All trees in the stand supported sizeable hollows. Under the spotlight, the animal let out a gurgling scream as it glided about 100 m upstream, using its long tail as a rudder, before landing on the trunk of another Manna Gum. After scrambling through the undergrowth, and in barely enough time to reach the tree, the animal alighted for a second glide along the creek. About 30 minutes later and 1200 m further upstream, at the junction of the Hunchback and Watsons Creeks, a Yellow-bellied Glider (possibly the same animal) was tracked again with the walkman, and another call was elicited. This time the animal had settled into feeding sap from a Manna Gum (see below).

In situations such as Watsons Creek, where optimal habitat is restricted to a 20 or 30 m wide strip of the creek, the glider, with the aid of its extraordinary mobility, is able to occupy a linear home range several kilometres long. There have been three sightings since 1986 on the Kinglake to Warrandyte link along the far eastern boundary of NEM (Steels Creek, Watsons Creek and Bend of Islands on the Yarra River).

Yellow-bellied Gliders are more common east of Toolangi in the Upper Yarra Ranges (Central Highlands). They are very rare in the Hume and Kinglake Ranges of NEM and have not been recently recorded in the connecting section of Toolangi State Forest between the Upper Yarra and Kinglake Ranges. Their optimal habitat is tall, old-growth eucalypt forest, particularly of mixed species in association with damp foothill watercourses. The association with watercourses would appear to be due to two factors. The first is the provision of large gum-barked eucalypts (preferred for nesting) and the second is the availability of contiguous habitat links (as the feeding/breeding behaviour of the species is reliant on mobility).

The habitats in which animals were seen in NEM included Mountain Grey Gum damp riparian forest (4.1), Messmate damp sclerophyll forest (4.2), Manna Gum riparian forest (5.3) and Manna Gum gully woodland (10.1). Juveniles disperse from the ranges and hills into neighbouring lowlands during autumn–winter. The animal seen along the Yarra River at the Bend of Islands was likely to have moved along the Watsons Creek habitat link connecting the Kinglake Ranges.

Social behaviour of the Yellow-bellied Glider. They are a highly social species living in family groups comprising a monogamous pair and their offspring of several years (Henry & Craig 1984). Groups have been seen in the Upper Yarra emerging from nest-tree hollows during dusk stagwatches. These groups occupy large territorial home ranges of 40–50 ha. They become highly active and mobile after the dusk emergence and usually tour the extremities of their territory over the same beat each night. Individuals within a group share a den, lined with fresh eucalyptus leaves in an old-growth tree hollow (Strahan 1988).

Yellow-bellied Gliders are highly vocal early in the breeding season and during autumn–winter when territoriality over feed-trees is most acute. The main call, uttered when gliding or foraging, commences with a series of loud gurgling screams and terminates in a series of splutters. Group members disperse widely over their home range and maintain contact by calling. The group identity and internal hierarchy is maintained by scent exchange from the dominant male and by mutual grooming (Henry & Craig 1984).

Feeding. Yellow-bellied Gliders are arboreal, confined to the upper levels of trees and take bark invertebrates (frequently), foliage invertebrates and plant exudates. Invertebrate prey are predominantly beetles, cockroaches, spiders, moths and flies (Henry & Craig 1984). Insects ranging in size from small psyllids to large cicadas are taken (Strahan 1988). Gliders search under the decorticating bark of gum-barked eucalypts which suspends from the upper trunk and branch whorls, or tear off strips of bark from Messmates.

Within the home range of a breeding group, they incise V-shaped notches through the bark to the cambial layer on the upper trunk and large branches of eucalypts. Trees that are heavily scarred are referred to as feed-trees. In NEM, several freshly scarred Mountain Grey Gums were observed along Full and Plenty Creek (tributary of Steels Creek). This indicates the presence of several animals and a likely breeding group. Heavily scarred feed-trees were not located along Watsons Creek. This may be an indication that the Yellow-bellied Glider does not breed there. Animals may be dispersing males from the breeding area along Full and Plenty Creek.

The phloem sap extracted from feed-trees contains sugars which are important as supplementary food during times when insect activity and availability is low. Scars are confined to particular trees within the group's territory. The gliders are very selective in their choice of feed-trees as they form an important social component of the group behaviour. Dominant animals in the group hierarchy appear to maintain the scars on the tree and use them as markers for territorial boundaries between neighbouring groups. A well-used feed-tree becomes heavily scarred after years of use. Feeding scars are re-opened each night to lick the exudates. As the sap flow declines over subsequent weeks, new scars are opened (Henry & Craig 1984).

Yellow-bellied Gliders also take manna exudates (often caused by insect damage) from leaves and under bark and nectar and pollen, particularly between autumn and spring, from large flowering eucalypts (e.g. Mountain Grey Gum). Honeydew exudates such as the lerp of psyllid insects provide an important energy source during drought when they are abundant and other food sources are scarce (Henry & Craig 1984). Pollen and nectar attracted insects are also an important component of the diet.

The gliders preferentially inhabit mixed species eucalypt forest. Extensive and diverse stands containing eucalypts with successive and non-overlapping flowering seasons provide year-round availability of food resources. This and the requirement of large patches of old-growth forests for nesting may partly account for their patchy distribution in NEM (see Steels Creek–Watsons Creek Headwaters, site 104).

Due to the scattered distribution and seasonal availability of much of their food, they occupy larger home ranges (i.e. have to search more widely) and occur at lower densities than similar sized herbivores such as the Greater Glider (Henry & Craig 1984). There appears to be a critical energy budget between effective foraging area and group size. Populations are prone to collapse after disturbances such as loss of dependable feed-trees or feeding habitat and links through logging or land clearing.

Ee **81^b: Red-bellied Black Snake and Lowland Copperhead.** Both were recorded along Watsons Creek between Butterman Track and the Kinglake NP boundary in April 1988. The black snake is uncommon along streams and gullies in well timbered parts of the Nillumbik Upland Hills. It is rare and has declined markedly over the last decade in the lowland hills and is close to extinction on the alluvial plains. The Lowland Copperhead was the most frequently recorded snake in the Nillumbik Upland Hills. This species has also declined in the lowland hills, as a result of human population, road traffic expansion and habitat fragmentation.

81^b: Valley forest/gully woodland bird census: Watsons Creek upstream of Butterman Track. (see chapter 5 in volume 1 for methodology) Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot consisted of two 500 m transects 20 m wide. It was situated amongst stands of bushland contiguous with Kinglake NP.

Degree of fragmentation: nil (all sides connected). Degree of thinning: low (tree density of 360/ha; regeneration from logging and fires). Degree of understorey and ground degradation: low (intact shrub and herb layers; dense shrubs along the creek and sparse shrub layers under the regrowth sclerophyll forest on the slopes).

Vegetation. Narrow bands of Yellow Box–Candlebark valley forest (31.1) on the southern side of Watsons Creek valley and Manna Gum gully woodland (10.1) along the creek. Red Stringybark herb-rich foothill forest (6.1) flanked the sheltered sides of the creek valley. Trees/ha (30% cover): 100 Red Stringybark, 80 Long-leaf Box, 48 Candlebark, 41 Yellow Box, 35 Red Box, 20 Narrow-leaf Peppermint, 20 Manna Gum, 10 Messmate and 6 Mountain Swamp Gum. Tall shrubs (20% cover); low shrubs (10% cover); herbs (30% cover).

Results. Bird summary: 60 species and 1252 individuals recorded (28 forest, 9 woodland, 17 shrubland and 6 fragmentation species); 62.6 birds/ha composed of 36.6 (58%) forest, 5.2 (8%) woodland, 17.6 (28%) shrubland and 3.2 (5%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (7.6), White-naped Honeyeater (4.1), Spotted Pardalote (4.0), Weebill (3.0), Buff-rumped Thornbill (2.9), Rufous Whistler (2.0), Crimson Rosella (1.7), Varied Sittella (1.4), White-throated Treecreeper (1.2), Yellow-faced Honeyeater (1.1), Red-browed Treecreeper (1.0), Satin Flycatcher (0.9), Australian King-Parrot (0.6), Brown-headed Honeyeater (0.6), Grey Currawong (0.5) and Shining Bronze-Cuckoo (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (2.3), Fan-tailed Cuckoo (1.0), Tree Martin (0.6) and Laughing Kookaburra (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (4.4), Grey Fantail (2.4), White-browed Scrubwren (2.1), Brown Thornbill (1.8), Golden Whistler (1.5), Grey Shrike-thrush

(1.2), Silvereye (1.0), Eastern Yellow Robin (0.9), White-eared Honeyeater (0.7), Eastern Spinebill (0.6) and Rufous Fantail (0.6)

Fragmentation species with densities exceeding 0.5/ha included the Bell Miner (2.2)

Parrots: 4 species and 2.7 birds/ha. **Canopy insectivores–migratory:** 11 species and 6.2 birds/ha; **non-migratory:** 8 species and 25.5 birds/ha

Discussion. 62.6 birds/ha, 31.7 (over 50%) of which were tree canopy insectivores (dieback control agents). The abundance of non-migratory canopy insectivores (over 25.5/ha) was the highest recorded of the 16 census plots. The plot contains some of the most contiguous (least fragmented) gully woodland system in NEM. It supports optimal bird abundance and diversity (relative to the other 15 census plots). It provides the control plot for assessment of the success rate of forest avifauna recruitment in revegetation areas. Note that apart from the Bell Miner, the abundance of fragmentation birds is the lowest of the 16 plots. Note also, the high level of shrubland birds (17.6 birds/ha).

This was the only valley forest/gully woodland census plot in which the Superb Lyrebird, Cicadabird, Australian King-Parrot and Eastern Whipbird were recorded. It was one of only two (of 16) in which the White-throated Nightjar, Crescent Honeyeater and Olive Whistler were recorded. The abundance of the canopy species, the Striated Thornbill, White-naped Honeyeater and Spotted Pardalote, was a major factor why leaf psyllid damage was extremely low. This is a widespread occurrence in valley forest/gully woodlands of NEM.

Conclusion. Diverse and viable canopy insectivore populations and low rate of eucalyptus dieback. Fragmentation would increase the Bell Miner population and increase the levels of leaf defoliation caused by insects.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Strategic Habitat Link. There is an intact riparian and overland link to the Steels Creek–Watsons Creek Headwaters site, an intact riparian link to the One Tree Hill–Watsons Creek Link and Watsons Creek to Christmas Hills sites, and intact overland links to the Diamond Creek Headwaters site and Sugarloaf Reservoir site. The site forms one of the most crucial faunal corridors in NEM as it provides the most intact and contiguous riparian habitat link between the ranges and lowland hills. Its role in the movements of fauna species from the Kinglake Ranges to the Yarra Lowland Hills is considerable.</p> <p>The upper section of the creek (upstream of Butterman Track), along with lower Jehosaphat Creek in the Steels Creek–Watsons Creek Headwaters site, forms the most intact and viable, foothill gully woodland and valley forest ecosystem in NEM. These are the only ones still containing, for example, Superb Lyrebirds, Yellow-bellied Gliders and Tree Goannas, which once extended throughout the range of the ecosystem in NEM.</p>	
<p>Decline of the Yellow-bellied Glider due to the clearing of habitat links. Over 70% of the native forest habitat in central and south-western Victoria which once supported the Yellow-bellied Glider has been cleared (Woodgate & Black 1988) or planted for softwood. Most of the remainder containing the glider is subjected to intensive logging and clearing. Few stands of mature forest remain. These effects have probably depleted over 70% of the range of the Yellow-bellied Glider in western Victoria and they are now locally extinct from large sections such as the Wombat Forest. Near Melbourne, this included the lowland riparian forest and gully and floodplain riparian woodlands that existed along the Yarra River and Plenty River. Lowland populations in central Victoria are dependent on narrow riparian links to the ranges such as Watsons Creek.</p> <p>The decline and population fragmentation of the glider in NEM may be partly due to the extensive clearing (for farmland) of connecting wet forest on the Kinglake Plateau between Kinglake West and Toolangi.</p> <p>This habitat needs to be protected from further clearing and links enhanced if the viability of the key Mt Slide population is to be maintained (see also Sooty Owl, in site 104). In NEM, the Kinglake to Warrandyte habitat link, particularly Watsons Creek, may be critical for the local survival of the Yellow-bellied Glider.</p>	<p>Strengthen strategic habitat link. The Watsons Creek Upper Reaches–Yarra Ridge site is critical for the connectivity of damp forest and riparian fauna (particularly mammals) between the ranges and lowland hills. The site is the key section of a contiguous riparian link between Kinglake NP and Warrandyte SP. Enhancement works in the link will create a more effective sanctuary for the increasingly isolated wildlife populations at Warrandyte. This will effectively increase the size and importance of Warrandyte State Park for wildlife as well as bolstering its own faunal significance</p> <p>An effective plan must be devised for linking riparian habitat between Kinglake and the Yarra and preventing further fragmentation. Streamway management is required including revegetation downstream of Butterman Track and weed removal. The link downstream of Butterman Track must be widened to ensure the movement of fauna along the corridor. Bushblocks within the site of significance containing substantially intact ground flora should be protected from livestock grazing. The future survival in NEM of species such as the Tree Goanna and Yellow-bellied Glider is dependent on improving the Watsons Creek to Yarra River Link</p> <p>Linking sites along Watsons Creek and at One Tree Hill are considered the critical nodes in the key habitat link between the Kinglake Ranges and the Yarra (Warrandyte State Park). One Tree Hill provides the main overland link and Watsons Creek provides the main riparian link. The primary conservation management priority for the Shire of Nillumbik is the re-establishment and function of these links.</p>

Fragmentation and degradation of the riparian link and bushblock expansion into hinterland bushland. The riparian link downstream of Butterman Track is narrow in sections, becoming weed invaded and being taken over by Bell Miners. Mountain Swamp Gums and Narrow-leaf Peppermints are dying in sections, such as that near the One Tree Hill Road bridge, because of the miners' presence.

The floodplain is intensively grazed. Stock have access to the creek at the rear of some properties along Osbornes Road. Yellow Box and Candlebark stands throughout have become fragmented by land clearing. The avifauna of these is noticeably of edge inhabiting species (e.g. alien species and Bell Miners). Foliage insect-induced dieback is noticeable among Mountain Swamp Gums on the lower floodplain and along gullies.

The linking and compatible management of bushland stands on private land through land protection and revegetation programs is considered essential. Incentives should be provided to property owners to undertake these activities. The entire streamway (100 m either side of Watsons Creek) requires fencing and intensive conservation management. Much of the streamway is already Public Land Water Frontage. This would improve the riparian ecosystem and water quality of the stream.

The quality of the ground stratum of much of the remaining box-stringybark woodland above Watsons Creek is also becoming degraded. Until recent years this formed some of the most intact ground layer vegetation under this habitat in NEM. Weeds resulting from residential bushblock development (e.g. septic tank leachate) and horse, cattle or goat grazing in some bushblocks has contributed to the decline. Small outbreaks of environmental weeds such as Montpellier Broom are expanding into major infestations. Land clearing causing fragmentation of habitat links has led to an increased ratio of predator to native prey population. Foxes and feral and domestic cats are eliminating ground fauna species such as the Common Dunnart and White-throated Nightjar.

Consolidate management on streamway private land in accordance with the LCC Conservation Link. See Watsons Creek to Christmas Hills site (64). Conservation covenants with specific, conditional and pro-active clauses regarding the protection of fauna and faunal habitat values are needed for this land. The purpose and benefits of covenanting should be promoted to landowners within or adjoining the site.

Consolidate management on streamway Melbourne Water land in accordance with LCC Conservation Link. Streamway land upstream of Happy Valley Creek in the proposed Watsons Creek dam inundation area under the ownership of Melbourne Water needs to be included in the conservation link if the dam proposal is not to go ahead. The Conservation Link of the proposed recommendations of the LCC Melbourne Area 2 does not include this section of Watsons Creek, yet this forms an unbroken streamway habitat link to Kinglake NP. One Tree Hill was included (affecting the overland habitat link) but the integral riparian component of the link along Watsons Creek was inexplicably omitted. This needs to be remedied. Other land within the site should be placed under appropriate conservation covenant before disposal. See the Watsons Creek to Christmas Hills (site 64).

Dewatering of Watsons Creek by farm dams and land clearing. Loss of flow due to farm and bushblock dams appears to have eliminated the Freshwater Blackfish from this section of the creek. The large dams on Waneroo are starving the creek of its natural flow. Water pollution (from turbid runoff and fouling of water in tributaries by livestock) and removal of riparian and floodplain vegetation has also contributed to the demise of blackfish.

Pollution emission controls and restrictions on further farm dams. Watsons Creek is the most significant third order stream for native fish in NEM. No further dams should be allowed in the catchment. Monitoring and control of septic tank leachate would be essential to maintain native fish and Platypus populations in downstream sections of the stream.

Other Issues

Firewood removal and vehicle entry in the section of the creek upstream of Butterman Track. Illegal removal of firewood is a common activity in the accessible section of the creek adjacent to the gas and fuel pipeline. Reptile and Common Dunnart habitat is being stripped from the area. Vehicles enter from Butterman Track and Wallaces Road. The level of rubbish dumping and car stripping is increasing. Control of these activities at One Tree Hill may have lead to an increase in them here.

Gas and Fuel pipeline—need for environmental protection works. Before the pipeline was installed in the early 1980s, a deputation of residents and scientists raised the question of the likely detrimental effects on habitat (e.g. Cinnamon Fungus, weeds, etc.). On the basis of faunal and floral values, the need for an environmental impact assessment was raised. A Gas and Fuel consultant's report on the proposed area indicated that it was unlikely to contain significant plants or animals. At the request of a resident a mammal survey was conducted and the Brush-tailed Phascogale and Common Dunnart were trapped on the proposed easement. The vulnerable Wine-lip Spider-orchid also grew on the proposed easement.

The corporation then indicated that it was going to minimise damage caused during the installation and that follow up repair work would be provided (see also the Bald Hill site). Earthwork from the installation of the pipeline at the Watsons Creek crossing has spread blackberries, Montpellier Broom and introduced grasses. The easement on the east side of the creek is traversed by vehicles and has become eroded. Red Stringybarks in low-lying sections near the pipeline are undergoing dieback, possibly caused by the Cinnamon Fungus.

Restrict vehicle entry to Watsons Creek upstream of Butterman Track. Blocking vehicle access from Butterman Track and Wallaces Road would reduce the amount of firewood removal and rubbish dumping. The advance of Blackberries and Montpellier Broom should be controlled in this area.

Native vegetation clearance controls (including extraction of firewood) on private land. It may be essential to regulate clearing of native bushland on private property in the site (particularly along the contiguous riparian link to Kinglake National Park) to protect flight corridors and foraging areas for the Common Bent-wing Bat and habitat links for the Superb Lyrebird and Yellow-bellied Glider.

LandCare group. Watsons Creek–Christmas Hills needs a LandCare group. Revegetation, weed control and consolidation of the habitat link along Watsons Creek should be the group's principal objective.

Planning Recommendations

Re-zoning and re-assessment of the use of streamway land owned by Melbourne Water. PPP 18 land in the streamway should be rezoned with appropriate considerations of its biological significance and value as habitat links to neighbouring sites (see also Long Gully Link site).

NUH B ST ANDREWS–SMITHS GULLY

This management unit consists of two sites of state faunal significance (sites 83 and 84) and one of regional faunal significance (site 82) and surrounding land that forms habitat links.

Map Reference: 7922 474368 to 7922 520437 (Diamond Creek); 7922 472363 to 7922 503347 (Smiths Gully Creek); 7922 483377 to 7922 509369 (Yow Yow Creek); 7922 485388 to 7922 509377 (Wild Dog Creek); 7922 497367 (Cant and Couties Mine/The Knobs); 7922 487372 Yow Yow Creek tunnel/mine); 7922 496374 (Yow Yow Creek valley forest/gully woodland bird census mid-point); 7922 500384 (Wild Dog Creek valley forest/gully woodland bird census mid-point).

Location/Size: Upper reaches of the Diamond Creek and lower and middle reaches and catchments of the Smiths Gully, Yow Yow and Wild Dog Creeks, north and east of St Andrews. Approximately 1740 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. The unit is essentially a low-lying system of valleys and streams fringed by upland areas separating neighbouring catchments. Three distinct geological bands run through it. The Silurian siltstone/mudstone, associated with the St Andrews anticline, occurs in the west. The central section is formed of Silurian sandstone. The eastern section (largely cleared) is formed of Devonian siltstone. It is an extension of the Kinglake Surface of the Great Dividing Range (see also the One Tree Hill unit).

The Knobs is a Devonian volcanic quartz-diorite plug lying on the transition of the Devonian and Silurian strata. The plug formed from a granitic magma intrusion into the overlying sedimentary strata from the earth's crust. It has been exposed by weathering as it was more resistant than the Silurian strata. Plugs often occur in weaknesses in the crust along faultlines or folds (anticlines and synclines). The compass exhibited a deal of ferromagnetic effect on The Knobs. The quartz-diorite plug is the origin of the reef and alluvial gold of the Caledonia diggings of Smiths Gully Creek.

Landforms

Foothill: quartz-diorite volcanic plug (The Knobs), ridges, hill-crests, hill-slopes, valleys, gullies, creeks (third and fourth order streams), dams and mines. Elevation is 140–320 m.

Hydrology

The Diamond Creek is perennial where it leaves the national park. By Mittons Bridge Road the flow reduces to a trickle in early autumn. During summer-autumn the Smiths Gully Creek, Yow Yow Creek and Black Calf/Broad Gully Creek contain strings of shallow pools and have intervening dry sections of several hundred metres long. They flow during winter-spring. Wild Dog Creek has a small catchment. It maintains a small flow fed from seepage during winter and runs intermittently after rains at other times of the year.

Before settlement, the Yow Yow and Smiths Gully creeks would have maintained a low flow over the summer. This flow would have been fed by springs arising in the sheltered headwater gullies (e.g. Dulcet Gully on the Willis Nature Reserve). The loss of flow over summer caused by land clearing and farm dams has led to dewatering of the creek and depletion of instream ecosystems. This in combination with more intensive land-use in the middle reach sections in recent decades has led to water salination and pollution (see Regional Hydrological Strategy).

Rainfall: 680–780 mm.

Site 82 Diamond Creek Upper Reaches

- Map Reference:** 7922 474368 to 7922 519437 (Diamond Creek); 7922 478398 (mid-point of the Neil's land). One minute lat/long grids include 37° 33' x 145° 18', 37° 34' x 145° 16' to 145° 18' and 37° 35' x 145° 16'.
- Location/Size:** Diamond Creek from School Road at St Andrews to Kinglake NP at the north end of Ninks Road. Approximately 640 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage (Diamond Creek from School Road to opposite the start of Ninks Road and joining Kinglake NP along Black Calf Creek and the lower section of Broad Gully Creek); NRE. Bushland Reserve (north and south of School Road to the west of Diamond Creek); NRE. Private: farmland (orchards and livestock) and bushblocks.
- Landforms:** Foothill (see NUH B). Elevation is 140–320 m.

Scientific and Educational Values

Invertebrates. The freshwater crayfish, *Euastacus yarraensis* was recorded while electrofishing the Diamond Creek at Halcyon (Ninks Road) on 15 April 1992 (Tarmo Raadik pers. comm.).

Scientific reference. Electrofishing sites and instream reference points in the Diamond Creek at Halcyon on Ninks Road and at Mittons Bridge Road.

HABITAT SIGNIFICANCE

Assessment: Medium–Category 2

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1)

FAUNAL SIGNIFICANCE: Site 82 Diamond Creek Upper Reaches

Assessment: Regional–Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

82^a: 37° 33' x 145° 18'; lower Ninks Road

82^b: 37° 34' x 145° 16'; Neil's bushland/Jacksons Road and Diamond Creek flats

82^d: 37° 35' x 145° 16'; Diamond Creek at Mittons Bridge

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 82^d: Bush Stone-curlew. One bird on 22 May 1993, on the Diamond Creek flats by the St Andrews–Kinglake Road near Butterman Track. Considered vagrant to the study area

c. Rare fauna

Regional. 82^b: Barking Owl, Painted Honeyeater, Brush-tailed Phascogale

Regional. 82^{ad}: Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 82^b: 9 species on 7 November 1991

h. Bats

Regional. 82^b: 5 species trapped at the vineyard dam on Neil's on 27 January 1992

i. Arboreal mammals

Local. 82^b: 3 species at Neil's on 1 March 1992

j. Ground mammals

Regional. 82^b: 5 species at Neil's on 1 March 1992 including the Brown Antechinus and Bush Rat (both trapped in the gully below the vineyard dam)

k. Frogs

Regional. 82^b: 8 species while spotlighting between the vineyard dam on Neil's and the Diamond Creek on 1 March 1992

l. Reptiles

Regional. 82^b: 9 species at Neil's and the adjacent flats of the Diamond Creek including the White's Skink, Delicate Skink, Weasel Skink, Eastern Three-lined Skink and Common Long-necked Tortoise on 27 January 1992

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 82^b: over 120 species

b. Native birds

Regional. 82^b: over 80 species

c. Native mammals

Regional. 82^b: 16 species

d. Herpetofauna

Regional. 82^b: 23 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 82^b: 14 species

b. Regionally endangered fauna (R1 species)

Regional. 82^b: 1 species. **Birds:** Painted Honeyeater

Regional. 82^d: 1 species. **Birds:** Bush Stone-curlew

c. Regionally vulnerable fauna (R2 species)

Regional. 82^b: 3 species. **Birds:** Barking Owl, White-throated Gerygone. **Mammals:** Brush-tailed Phascogale

d. Regionally rare fauna (R3 species)

Regional. 82^b: 2 species. **Birds:** Spotted Quail-thrush, Masked Woodswallow

Regional. 82^a: 1 species. **Birds:** Pink Robin

e. Regionally depleted fauna (R4 species)

Regional. 82^b: 8 species. **Birds:** Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Bassian Thrush, Speckled Warbler. **Reptiles:** White's Skink, Red-bellied Black Snake

Regional. 82^d: 2 species. **Birds:** Rainbow Bee-eater. **Fish:** Mountain Galaxias

Regional. 82^a: 2 species. **Birds:** Eastern Whipbird. **Fish:** Mountain Galaxias

f. Regionally restricted fauna (R5 species)

Regional. 82^b: 11 species. **Birds:** Painted Button-quail, Brush Bronzewing, Nankeen Night Heron, Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Common Long-necked Tortoise, Delicate Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

Local. 82^a: 3 species. **Birds:** Brush Bronzewing, Red-browed Treecreeper. **Mammals:** Koala

F. POPULATION DENSITY: Viability and Abundance–point census

j. Electrofishing rate

Regional. 82^a: 72 Mountain Galaxias in the Diamond Creek at the north end of Halcyon (Ninks Road) on 15 April 1992

n. Regionally depleted fauna (R4 species)

82^a: See *Fj*

Regional. 82^d: 10 Mountain Galaxias electrofished in the Diamond Creek at Mittons Bridge Road on 15 April 1992

Outlook

While the faunal significance is Regional Category 1 (19 sub-criteria), without adequate conservation management it will decline through a lack of effective habitat links. With increasing bushblock subdivision, the substantial population of Mountain Galaxias in the Ninks Road section of the Diamond Creek may be under some threat. The water quality at Mittons Bridge Road and sections downstream in St Andrews township has deteriorated in recent years due to domestic water discharge and septic tank leachate.

FAUNA

Rare or Threatened Fauna

Bb 82^d: Bush Stone-curlew. A confirmed sighting was made on the evening of 22 May 1993, on the Diamond Creek flats in ex-Manna Gum (floodplain terrace) riparian forest; 5.2) by the St Andrews–Kingleake Road near Butterman Track (Danny Rogers pers. comm.). The stone-curlew has not been recorded in the hills of NEM for over 70 years. The former range would have included the stream valleys of the lowland and upland hills. The nearest occurrences are in northern Victoria in the foothills of the Strathbogie Ranges, in similar habitat consisting of riparian forest and partially cleared farmland.

Further sightings have not been made so the record is treated as a vagrant. The species becomes locally mobile in northern Victoria during autumn–winter but is not known to undertake movements of this distance. It is remotely possible that a population of stone-curlews persists in the upper Diamond Creek valley. Areas such as the abandoned creek flat orchards upstream of Mittons Bridge Road provide refuges. If this were the case, the population would be small and highly threatened by predation from cats and foxes.

The Bush Stone-curlew persisted in NEM until the 1940s on the volcanic plains. It declined dramatically in the first half of the twentieth century in southern Victoria, where it is now close to extinction. It remains in northern Victoria on the alluvial and riverine plains, where it is listed as vulnerable.

Bc 82^b: Painted Honeyeater. Two male birds were seen on 7 November 1991 below Jacksons Road, in Yellow Box–Candlebark valley forest (31.1) near the vineyard dam on Neil’s block. This was one of only two sightings in NEM during the study (the other at Memorial Drive at Plenty–Janefield, site 42). Yellow Box, Red Stringybarks and Mountain Swamp Gums in the valley of the vineyard dam were infested with both the Drooping and Box Mistletoes. The fruit of the Drooping Mistletoe is the essential food of the Painted Honeyeater in NEM. The mistletoe had finished flowering one or two months earlier and the ripening fruit had attracted the honeyeaters.

The males seen at Jacksons Road were in full voice ‘Georgee–Georgee–Georgee’ and had set up breeding territories. One of the males commenced building a nest in a clump of mistletoe. No females were present. They usually arrive several weeks later than the males, often when the nest building is completed. Several pairs will nest in close proximity in a suitable mistletoe grove. On the next visit (27 January 1992) none were present. If they bred, they had moved on. They breed quickly after the females arrive and will just as quickly vanish (as does their food supply) as soon as the young can fly.

Painted Honeyeaters are summer migrants from northern Australia. Movements are poorly known and their appearance locally depends on the availability of mistletoe fruit. Small numbers enter southern Victoria every few years but they have become very rare over the last two decades. They return to traditional nesting areas and breed in loose colonies composed of two to a dozen pair. They were seen on two occasions in the 1970s downstream at St Andrews between the market grounds and the football oval. The birds have not been sighted there for 15 years. Several of the old Yellow Box that were infested with mistletoe have since died.

- Bc* **82^b: Barking Owl.** The owls have been frequently heard on Neil’s block (David Bathgate pers. comm.).
- Bc* **82^b: Brush-tailed Phascogale.** A phascogale was seen leaving a hollow of a dead tree along Mittons Bridge Road near the corner of Hildebrand Road and Jacksons Road in 1990.
- Bc* **82^{ad}: Mountain Galaxias.** Electrofishing: 72 in the Diamond Creek at the north end of Halcyon (Ninks Road) on 15 April 1992 and 10 in the Diamond Creek at Mittons Bridge Road on 15 April 1992.

Other Significant Fauna

Birds

82^b: Ground birds on Neil’s block. The Painted Button-quail, Spotted Quail-thrush and Bassian Thrush were recorded. The button-quail was seen on 1 March 1992 amongst the open Grey Tussock-grass on a stony ridge containing Red Box–Red Stringybark box–stringybark woodland (11.1), north of the vineyard dam. It had been seen on 27 January 1992 and possibly bred there. The quail-thrush was breeding on 7 November 1991 amongst dense Silvertop Wallaby-grass on the lower slopes nearer the Diamond Creek. It was also seen on 1 March 1992. The Bassian Thrush was seen amongst the dense Burgan on the slope between the vineyard and the creek on 27 August 1990. These three ground-dwelling species remain largely because of the low density housing and domestic cat population at the location. The regrowth stands of Burgan are utilised by the Spotted Quail-thrush and Bassian Thrush.

82^b: Migratory insectivorous birds of the riparian forest, valley forest and gully woodland on Neil’s block. Nine breeding canopy insectivore species were seen on 7 November 1991 during a 60-minute search between Neil’s vineyard dam and Muller’s orchard on the Diamond Creek flats. The habitats searched included Yellow Box–Candlebark valley forest (31.1), Messmate–Mountain Swamp Gum gully woodland (10.2), Manna Gum (floodplain terrace) riparian forest (5.2), and Manaa Gum (creek) riparian forest.

Birds included the Leaden Flycatcher (several pair with birds sitting in cup-nests on Yellow Box limbs), Satin Flycatcher (one pair in a Messmate), Olive-backed Oriole (several pair in Yellow Box and Mountain Swamp Gums), White-throated Gerygone (a pair in a Yellow Box), Sacred Kingfisher (Manna Gum hollow by the Diamond Creek), Rufous Whistler (perhaps six nesting pair in Yellow Box on the lower slopes), White-winged Triller (a pair in a Manna Gum) and Masked Woodswallow (Silver Wattle along the Diamond Creek). Four species of cuckoos were in full voice and all likely bred (Brush Cuckoo, Fantailed Cuckoo, Shining Bronze-Cuckoo and Horsefield’s Bronze-Cuckoo). In addition, the Rainbow Bee-eater, which is becoming rare, was seen entering a hollow in a creek bank downstream of the orchard.

Mammals

82^b: Bats in the roof of the mudbrick cottage on Neil's block. Five species (Lesser Long-eared Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Little Forest Bat and Large Forest Bat) live in the roof of the cottage next to Norma Neil's vineyard (Bathgate's cottage). These species were trapped on 27 January 1992 near the vineyard dam. They were individually released next morning in front of the cottage. Each flew around the cottage and landed on the top of the wall, crawling in through the tiny crevices under the corrugated iron roof. These species live in communal groups and are relatively opportunistic over living space. All bats that entered the cottage roof were males. The female Little Forest Bats headed for a nearby hollow tree stump, where they lived in the root cavity. This probably formed a maternity colony as two of the females were lactating and likely had bittens in the cavity.

Reptiles and frogs

82^b: Red-bellied Black Snake and other herpetofauna species. The habitat and landform diversity and low density housing in the section of the Diamond Creek fronting Muller's orchard and Neil's block provides for a diverse herpetofauna assemblage. Twenty-three species were recorded. Three species of snakes were present. The locally rare Red-bellied Black Snake was seen on the bank of Diamond Creek. Both species of blue-tongued lizards, the Tree Dragon and five species of skinks were recorded. The dragon was seen under Red Box–Red Stringybark box–stringybark woodland (11.1) on the ridgeline north of the orchard dam. The Southern Water Skink lives along the creek and terraces (5.2/5.3) and the Eastern Three-lined, Delicate and White's Skinks were located on the creek escarpment under the Burgan thickets (6.1). The Weasel Skink was under logs amongst Austral Bracken and Common Tussock-grass on the sheltered slopes under Red Stringybark herb-rich foothill forest (6.1).

The frogs were mainly in the valley of Neil's vineyard dam. The dam supported populations of the Growling Grass Frog, Striped Marsh Frog and Common Bullfrog. The gully and sheltered slopes between the dam and the creek flats contained the Southern Toadlet and Victorian Smooth Froglet.

Freshwater fish

82^a: Electrofishing Survey: Diamond Creek–Ninks Road at north end of Halcyon

Map reference. 7922 507415. **Altitude.** 220 m. **Survey date.** 15 April 1992 and 2 July 1992 (water quality and flow readings)

Vegetation. Instream: emergent herbfield. Bank: Manna Gum riparian forest (5.3; fair condition). Frontage: Messmate herb-rich foothill forest (6.3; poor condition and weed invaded)

Physical Features:

Pools

Substrate. Some silt and gravel, pebbles, cobbles, sand, branches and logs on sheet sandstone; log jams above riffles at downstream end of pools

Maximum size (mid-autumn). 1.5 m wide by 0.5 m deep by 20 m long

Riffles

Substrate. Gravel, pebble, cobble and sand on sheet sandstone; cascades

Flow (mid-autumn minimum): **Size.** 0.5 m wide by 5 cm deep. **Velocity.** 0.6 m/sec. **Rate.** 3.5 ML/day

Flow (mid-winter normal): **Size.** 1.5 m wide by 8 cm deep. **Velocity.** 0.6 m/sec. **Rate.** 17.1 ML/day

Water quality

Autumn: Temperature. 15.2°C. Conductivity. 110 ms. Salinity. 0 ppt. Turbidity. Moderate

Winter: Temperature. 10.2°C. Conductivity. 54 ms. pH. 6.63. Dissolved Oxygen. 11.4 ppm. Turbidity. Clear

Fish Recorded During Survey

Native species numbers/status: Mountain Galaxias (72); large population; likely breeding resident. The upper reaches of the Diamond Creek contains the largest population of Mountain Galaxias in the Shire of Nillumbik and one of the largest in NEM.

Alien species numbers/status: Nil.

Other comments. The spiny crayfish, *Euastacus yarraensis* was recorded. Land tenure: freehold bushland and adjacent farmland.

82^d: Electrofishing Survey: Diamond Creek–Mittons Bridge Road

Map reference. 7922 485386. **Altitude.** 155 m. **Survey date.** 15 April 1992 and 2 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum riparian forest—creek (5.3; poor condition and weed invaded). Frontage: Manna Gum (floodplain terrace) riparian forest (5.2; poor condition), Yellow Box–Candlebark valley forest (31.1; poor condition) and Red Stringybark herb-rich foothill forest (6.1; poor condition with woody and grassy weeds)

Physical Features:

Pools

Substrate. Deep silt, logs, branches and some urban refuse on sheet sandstone; log jams at downstream end of pools; channel scoured

Maximum size (mid-autumn). 2.0 m wide by 1.6 m deep by 30 m long

Riffles

Substrate. Gravel and cobble on sheet sandstone

Flow (mid-autumn minimum): **Size.** 0.5 m wide by 2 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 0.95 ML/day

Flow (mid-winter normal): **Size.** 3.0 m wide by 5 cm deep. **Velocity.** 0.6 m/sec. **Rate.** 21.4 ML/day

Water quality

Autumn: Temperature. 17.0°C. Conductivity. 210 ms. Salinity. 0 ppt. Turbidity. Cloudy

Winter: Temperature. 10.0°C. Conductivity. 125 ms. pH. 6.34. Dissolved Oxygen. 11.3 ppm. Turbidity. Clear

Fish Recorded During Survey

Native species numbers/status. Mountain Galaxias (10); likely breeding resident. The site yielded just ten Mountain Galaxias and was of noticeably inferior water and riparian habitat quality than site 82^a

Alien species numbers/status. Nil

Other comments. A substantial population of the alien crustacean, *Cherax destructor* (yabby) was recorded. Land tenure: Water Frontage and adjacent uncommitted Crown land and farmlets/bushland.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. There are intact links to the Diamond Creek Headwaters site and Yow Yow Creek site and fragmented links to the Cottles Bridge to St Andrews site, Chadds Creek site and Hewitts Road site. The site acts as a linear but important foothills habitat link between the Kinglake Ranges and Nillumbik Lowland Hills. It serves an important role in the movement and maintenance of mountain forest fauna in the Cottles Bridge to St Andrews site. The narrowness and degraded nature of sections (e.g. downstream of Mittons Bridge Road at St Andrews township) reduces the effectiveness of the link and is a bottleneck to this movement.</p>	
<p>Housing/opening-up of outlying bushland—habitat link severance. The increasing numbers of houses and subdivisions are threatening already restricted faunal habitat links through land clearing and degradation and disturbance (see other sites in this unit and in the Strathewen unit).</p>	<p>Strengthen habitat links.</p>
Regional Hydrological Strategy	
<p>Electrofishing site: Halcyon. Blackberry advance; bank undercutting. Livestock have caused damage to the bank because the bridge forms an access between the sections of the property to either side of the creek. Unconfirmed reports suggest that raw sewage is discharged from several houses upstream.</p> <p>Electrofishing site: Mittons Bridge. High turbidity/siltation rate; severely depleted summer-autumn flow rate; roadway above east bank. An instream weir (old orchard dam) upstream of Mittons Bridge Road would at least partially block the migratory movements of fish. There is inadequate native instream and riparian cover, some bank erosion-slumping and gullying and tree and bank undercutting, advancing weeds, and tree dieback. Vehicles have entered under the bridge from Mittons Bridge Road and driven along the course of the creek. This has caused severe damage to the creek channel.</p>	<p>Electrofishing site: Halcyon. Drinking water is taken from the creek. Water quality controls determine the release of untreated human sewerage to be an illegal activity in the Yarra River basin. This activity must be investigated including tests for organic nitrates and phosphates and <i>E. coli</i>. Releases exceeding acceptable standards need to be stopped. This is an important section of the stream for the Mountain Galaxias.</p> <p>Electrofishing site: Mittons Bridge. This section will need special targeting for land and water protection and habitat link enhancement works if stream conditions essential for native fish and Platypus are to be achieved. Implementation of the Regional Hydrological Strategy would require sound water management practices over the entire catchment to cater for the ecological requirements of native fish. Reinstatement of a natural flow regime may ultimately provide breeding grounds for the vulnerable Australian Grayling (which is now able to enter the Yarra catchments with the installation of a fish-way at Dights Falls).</p>

The autumn flow had decreased substantially from that upstream at Halcyon. Water is drawn off upstream for orchard irrigation dams or held back in farmlet/bushblock dams. The loss of water over this and downstream sections is the most serious threatening process (of several) acting on native fish in the Diamond Creek.

Poor water quality of the Diamond Creek downstream of Mittons Bridge Road. When electrofished in April 1992, the water quality and quantity had deteriorated noticeably from sites upstream. The Mountain Galaxias population had also declined. The creek flats upstream of Mittons Bridge Road were developed for orchard land. Sections were cleared of native vegetation to the waters' edge. Much of the orchard land has been abandoned and Willow, Hawthorn and Blackberry now dominate the banks. Stock graze to the eastern edge of the creek. Severe bank slumping and stream channelisation has occurred. Polluted water input from upstream housing has taken effect.

The St Andrews township section is the poorest for native fish in the middle/upper reaches of the Diamond Creek. It has relatively poor water quality and degraded substrate and vegetation. The problem lies with the proximity of the unsewered township of St Andrews. Houses are set adjacent to the banks and native riparian vegetation is lacking or chronically over-run with weeds and degraded. Household waste water is discharged directly into the creek without any settling areas.

The old orchard weir upstream of Mittons Bridge Road should be decommissioned. This structure aside, the Diamond Creek is the only perennial third order stream in NEM which does not have an artificial barrier to migratory fish at some point over its length. With the absence of Brown Trout (which occupy dams in other streams), the creek may be important for migratory species such as the Common Galaxias and Pouched Lamprey (once recorded from downstream at St Andrews). Upgraded conservation management in this section would benefit the native fish and other instream biota of the entire system.

Other Issues

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat.

Site 83 Smiths Gully Creek

- Map Reference:** 7922 472363 to 7922 502347 (Smiths Gully Creek at St Andrews market grounds to Smiths Gully Road opposite Joyces Road); 7922 477347 (Smiths Gully Creek/Dulcet Gully at Willis Reserve valley forest/gully woodland census plot); 7922 474347 (Peter Franke Reserve valley forest/gully woodland census plot mid-point); 7922 468357 (St Andrews Wildflower Reserve). One minute lat/long grids include 37° 36' x 145° 15' to 145° 16' and 37° 37' x 145° 16' to 145° 17'.
- Location/Size:** Lower and middle reaches of the Smiths Gully Creek, east and south-east of St Andrews. Approximately 650 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage (K1, LCC 1977; Smiths Gully Creek from Proctor Street to Salters Rush Road including Queenstown Cemetery/Peter Franke Reserve and a tributary upstream of Salters Rush Road, between Rifle Range Road and Butterman Track—NRE); Bushland Reserve (St Andrews Common between Shaftesbury Avenue and Butterman Track, a block west of Smiths Gully Creek between Smiths Gully Road and Proctor Street and a block on the north-west corner of Kangaroo Ground—St Andrews Road and Kerrs Road—NRE); St Andrews Wildflower Reserve (Flora Crescent St Andrews—Shire of Nillumbik); Public Open Space (5 ha block between the Willis Nature Reserve and the Proctor Street ford of Smiths Gully Creek—Shire of Nillumbik); uncommitted Crown Land (several small blocks—NRE). *Please note.* Discrepancies between boundaries and locations of these blocks occur between differing map sources. Actual boundaries are difficult to determine on the ground. These should be clarified for management purposes. Private: Trust for Nature (Victoria) (Willis Nature Reserve). Some of the bushland has regenerated from previous clearing. Farmlets (generally horses and cattle) and bushblocks of 8–20 ha. Some stud properties in the open land to the east of the site.
- The Willis Nature Reserve.** The land fronts almost 2 km of the Smiths Gully Creek and lies between the creek and Black Cameron Road. It was purchased in 1965 for the purpose of wildlife conservation (Lyle Willis pers. comm.). The Trust for Nature (Victoria) purchased an 8 ha block in 1983 and the adjoining 72 ha block was donated in 1986 to the trust by Mr Willis, who currently manages the reserve. Much of the land has been previously cleared and grazed but has undergone extensive revegetation over the last 25 years. The Willis Nature Reserve is covenanted with explicit purposes for conservation and represents one of the most positive conservation statements made in NEM.
- Landforms** Foothill (see NUH B). Elevation is 140–270 m.

Natural Heritage Values

Landscape. The Willis Nature Reserve, along with adjoining properties (a further 100 ha), provides the most extensive and contiguous area of foothill forest vegetation in the middle Diamond Creek catchment. The area forms one of the most intact representations of stream and foothill landforms, fauna and habitats in NEM. It contains the most diverse gully woodland, box-stringybark woodland, valley forest, and herb-rich foothill forest assemblage in NEM (i.e. seven sub-communities and 12 species of eucalypts).

The lower altitudinal range of Yellow Box–Candlebark valley forest (50–150 m) in the lowland hills of NEM has been heavily cleared and fragmented and extensively modified. The most extensive and intact stands occur in its upper altitudinal range (150–250 m). These are tucked under the foothills of the ranges across the northern section of NEM. The most intact and extensive stands are present within this site, the

Watsons Creek to Christmas Hills site, the neighbouring Yan Yean Reference Area site and Ridge Road–Sherwin Range Catchment site.

Scientific and Educational Values

Scientific reference. Dulcet Gully on the Willis Nature Reserve and the Peter Franke Reserve, form valley forest/gully woodland census plots (see Regional Habitat Link Strategy).

HABITAT SIGNIFICANCE

Assessment: High–Category 2

Reference stands: Messmate–Mountain Swamp Gum gully woodland (10.2; Smiths Gully Creek); Yellow Box–Candlebark valley forest (31.1; valley off Smiths Gully Creek)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Mountain Swamp Gum gully woodland (10.2)

Partially intact or small stands: Red Box–Red Stringybark box–stringybark (11.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Manna Gum (creek) gully woodland (10.1; lower Smiths Gully Creek)

Vulnerable species: Wine-lip Spider-orchid

Critical assemblages or populations: Strategic Habitat Link. Gully woodland and valley forest along Smiths Gully Creek flanking the Willis Reserve and Peter Franke Reserve

FAUNAL SIGNIFICANCE: Site 83 Smiths Gully Creek

Assessment: State–Category 3 (B, C, D, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

83^b: 37° 36' x 145° 16'; Willis Reserve/Black Cameron Road/lower Smiths Gully Ck

83^c: 37° 37' x 145° 16'; Queenstown Cemetery/Peter Franke Reserve

83^d: 37° 37' x 145° 17'; Smiths Gully Road/Salters Rush Road/One Tree Hill Road

B. RARITY: Rare or Threatened Fauna

a. Rare fauna

State. 83^c: Barking Owl, Powerful Owl, Brush-tailed Phascogale, Common Dunnart, Large-footed Myotis, Tree Goanna

Regional. 83^b: Barking Owl, Powerful Owl

Regional. 83^d: Brush-tailed Phascogale, Common Dunnart

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

State. 83^c: 11 species on the Dulcet Gully valley forest/gully woodland census plot in October 1989

h. Bats

Regional. 83^c: 6 species including the Gould's Long-eared Bat trapped on 21 November 1990 at a dam in the eastern section of the Willis Reserve

i. Arboreal mammals

Regional. 83^c: 6 species including the Mountain Brushtail Possum, Feathertail Glider, Sugar Glider and Koala in Dulcet Gully on the Willis Reserve on 27 February 1993

j. Ground mammals

Regional. 83^c: 5 species including the Long-nosed Bandicoot, Common Wombat, Black Wallaby and Bush Rat in Dulcet Gully on the Willis Reserve on 27 February 1993. Five species including the Common Dunnart downstream of the Franke Reserve on 28 December 1987

k. Frogs

Regional. 83^c: 6 species including the Victorian Smooth Froglet and Striped Marsh Frog at Peter Franke Reserve on Smiths Gully Creek on 11 March 1989

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 83^c: 132 species

b. Native birds

Regional. 83^c: 87 species

c. Native mammals

State. 83^c: 24 species

d. Herpetofauna

Regional. 83^c: 21 species

f. Butterflies

Regional. 83^b: 29 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 83^c: 22 species

b. Regionally endangered fauna (R1 species)

Regional. 83^c: 2 species. **Birds:** Little Friarbird. **Mammals:** Large-footed Myotis

Regional. 83^b: 1 species (incidental obs.). **Birds:** Little Friarbird

c. Regionally vulnerable fauna (R2 species)

State. 83^c: 10 species. **Birds:** Barking Owl, White-throated Nightjar, Azure Kingfisher, Cicadabird, White-throated Gerygone, Chestnut-rumped Heathwren. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot. **Reptiles:** Tree Goanna

d. Regionally rare fauna (R3 species)

Regional. 83^c: 5 species. **Birds:** Spotted Quail-thrush, Pink Robin. **Mammals:** Mountain Brushtail Possum, Feathertail Glider, Gould's Long-eared Bat

Regional. 83^b: 1 species (incidental obs.). Spotted Quail-thrush

e. Regionally depleted fauna (R4 species)

Regional. 83^c: 5 species. **Birds:** Leaden Flycatcher, Eastern Whipbird, Bassian Thrush, Speckled Warbler. **Reptiles:** Red-bellied Black Snake

Regional. 83^b: 2 species. **Butterflies:** Flame Skipper, Spotted Brown

f. Regionally restricted fauna (R5 species)

Regional. 83^c: 12 species. **Birds:** Painted Button-quail, Brush Bronzewing, Nankeen Night Heron, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

Local. 83^b: 4 species. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Dark Purple Azure

F. POPULATION DENSITY: Viability and Abundance–point census

i. Bat trapping rate

Regional. 83^c: trap-night average of 17 animals (6 species) at a dam in the -eastern section of Willis Nature Reserve on 21 November 1990

n. Regionally depleted fauna

Regional. 83^c: 14 Leaden Flycatchers (7 breeding pairs) recorded from a 5 ha/60-minute count in valley forest in the Dulcet Gully/Smiths Gully Creek section of Willis Nature Reserve/Peter Franke Reserve in October 1989. This was the highest population density of this species recorded in NEM. Ten Speckled Warblers were also recorded in the Black Wattle/Burgan regrowth on the exposed hill-slopes of Dulcet Gully in October 1989.

Outlook

The faunal significance may decline from State to Regional if the rate of bushblock housing density increases. This is due to an inability of fauna (particularly the ground fauna) to cope with rising levels of habitat fragmentation, predation and impact from humans. A strengthening of habitat links is required to reverse the effect of fragmentation from historical land clearing.

FAUNA

Rare or Threatened Fauna

Bc 83^{bc}: Barking Owl. They were heard calling in valley forest (31.1) on several occasions and were suspected of breeding in Dulcet Gully on the Willis Nature Reserve. They have also been heard downstream near the Proctor Street ford (Pat Reynolds pers. comm.). A large Yellow Box in Dulcet Gully was found to be a feeding roost. Regurgitated pellets located on 30 November 1989 under the tree contained bone fragments and fur of Sugar Gliders, Common Ringtail Possums and rabbits and a jawbone of a Brush-tailed Phascogale. Another pellet contained a racing pigeon band, probably taken while the pigeon was sleeping. A tail of a Sugar Glider was located near the tree.

Bc 83^{bcd}: Powerful Owl. There are numerous reports from local observers and a breeding pair in the site had been suspected for several years. In this study, one was heard calling from downstream of the Peter Franke Reserve on 28 December 1987. Another bird was seen in the car headlights at Proctor Street ford of Smiths Gully Creek on 3 October 1989. They have been frequently heard calling nearby at Shaftesbury Avenue each year from 1993 to 1996 (Aaron Saper pers. comm.) and over a longer period at Proctor Street (Pat Reynolds pers. comm.). The owls were resident near Black Cameron Road from November 1995 to December 1996 and are presumed to have nested in winter–spring 1996. This pair will be monitored over the next breeding season.

One of the determining criteria for the site to be a Strategic Habitat Link is that it is of high significance in the context of the region (NEM) for Powerful Owls. (for further discussion see Regional Habitat Link Strategy in Volume 1). This is because it supports extensive and intact stands of habitat, optimal prey and cover diversity and availability of nest trees. Optimal cover of mid-canopy wattles (for roosting and prey) is a successional feature. Much of the wattle was germinated after the 1962 bushfire. This is starting to senesce. Provision for regeneration and future cover of Blackwoods and Black Wattles is required (e.g. tree guards around young plants as protection from wallabies).

The owls are also dependent on protection of habitat in the nesting area. The integrity and naturalness of local gullies and hill-slopes will be critical in maintaining prey populations. Routine works should include removing weeds such as Bulbil Watsonia, Spanish Heath and Blackberry. Of most importance to continued nesting of the owl, is that human disturbance is kept to a minimum. Of equal importance to prey

populations is that habitat links, particularly to the ranges and One Tree Hill, be kept intact. Those that are 'weakened' by land clearing need to be enhanced.

The following information on the Powerful Owl has been kindly provided by Beth Wykes.

The pair was first observed on 12 November 1995. Over the ensuing five months they were frequently observed roosting in a stand of Black Wattle and Blackwood on a sheltered hill-slope in Messmate herb-rich foothill forest (6.3). After several months of silence, territorial calling of the male and female was heard in the night of 7 February. It appears that nesting territory and pair bonding were being established. This continued through February, March and April. From 8 May to the end of October only the male was observed. It is presumed that the female had commenced roosting in a tree hollow, in preparation to nesting. It is further presumed that these are different birds from the pair at One Tree Hill (about 4 km away), as the latter were involved in nesting activity over the same period. The adult male and female at One Tree Hill and the male at Smiths Gully were both observed in their respective areas on 20 May 1996.

During September and October 1996, the male at Smiths Gully was frequently observed at the Black Wattle–Blackwood roost and occasionally heard during the night. A nearby gully supported Messmate–Mountain Swamp Gum gully woodland (10.2) and two very large Manna Gums. One of these (later suspected to have been the 'nest-tree'), was around 35 m tall with a diameter at breast height of 75 cm. It had three or four hollow spouts probably 25–30 cm in diameter which radiated out of the trunk, 20–25 m up. This indicates that the central trunk is hollow at this point. The tree is estimated to be over 150 years old and of adequate age and size to support a nesting Powerful Owl, though unconfirmed at this stage.

On 1 November 1996 the female rejoined the male. The trilling of a third individual, which may have been a newly emerged juvenile was also heard. The adults became vocal over the following weeks, resuming the territorial 'woo-hoo' heard in autumn and also issuing a courting or pair bonding call 'poorp-poop-poop'. On 24 November a third adult bird was heard (possibly an offspring from a previous year). On 1 December a well-grown fledgling was observed for the first time. The age of the fledgling (since hatching) may have been around four months but this is difficult to assess. The incubation period of the Powerful Owl is normally five weeks and the hatchling period inside the nest is 9–10 weeks. Until the time of writing (6 December) the juvenile has been observed sitting near the female, with the male close-by in the Black Wattle–Blackwood roost. On 3 December, the juvenile was observed taking a competent 100 m flight, trilling as it went.

Pellets of the Smiths Gully birds are being collected for dietary analysis. Preliminary data on a sample collected in July and August under the male roost contained the remains of the Common Ringtail Possum (60%), Common Brushtail Possum (32%) and Sugar Glider (8%). Over this period and the following two months the male was also providing food for the female and the newborn. In areas such as Smiths Gully where the Powerful Owl and Barking Owl overlap, a small component of the diet of the former may include ground mammals that are too large for the latter. This may include the Bush Rat and Long-nosed Bandicoot (e.g. inexperienced juveniles).

Analysis of pellets of the Barking Owls at nearby Dulcet Gully revealed that as well as rabbits (for which it hunts in open areas where the Powerful Owl does not go), they contained a component of smaller arboreal prey such as the Brush-tailed Phascogale and Sugar Glider. These are not critical to the Powerful Owl. The two owls co-exist successfully, by specialising in different habitat for different prey. Both owls can occasionally be seen, and even nest, close by each other. Each of these additional prey has been recorded in the site.

Bc **83^{cd}: Brush-tailed Phascogale and Common Dunnart.** A phascogale was recorded in autumn 1986 in a nest box located near the intersection of One Tree Hill Road and Smiths Gully Road (David Hespe pers. comm.). The Common Dunnart was recorded in a vegetable garden at the same location (David Hespe pers. comm.). The surrounding bushland contains Red Box–Red Stringybark box–stringybark woodland (11.1) on the hill-crests and exposed slopes, Red Stringybark herb-rich foothill forest (6.1; with

dense understorey of Grey Tussock-grass and Silvertop Wallaby-grass) on the sheltered slopes while Yellow Box–Candlebark valley forest (31.1) occupies the valleys.

A female Common Dunnart was located in a nest inside a hollow log on a hill-slope (6.1) above the Smiths Gully Creek downstream of Peter Franke Reserve on 28 December 1987. A Barking Owl pellet located in Dulcet Gully on the Willis Reserve on 30 November 1989 contained the jaw of a Brush-tailed Phascogale. The phascogale appears to be widespread in the site, largely due to the extent and connectivity of the bushland and low housing density. The species has declined dramatically from areas in NEM closer to Melbourne through habitat clearing and fragmentation and cat predation.

Bc **83^c: Large-footed Myotis.** One of only two trappings of this species in NEM was on Smiths Gully Creek at Peter Franke Reserve. The bat-trap was placed in the water at the upstream end of the battery dam under Messmate–Mountain Swamp Gum gully woodland (10.2). Just upstream, at the confluence of Dulcet Gully, small caves with openings large enough for bats to enter were located in the rock face of cliffs along the creek. Bat droppings were present outside one of the entrances. It is possible that the Large-footed Myotis roosts in these, or behind rock-slabbing downstream of the battery dam near the confluence of the gully leading up to Black Cameron Mine. The myotis have not been located in mines and all observations in GM were near permanent water.

Bc **83^c: Tree Goanna.** One was seen near Peter Franke Reserve in 1986 (David Hesse pers. comm.). This was likely a dispersing animal from the Kinglake Ranges, which demonstrates the operative habitat links to the national park.

Critical Assemblages or Populations

Cf **83^c: High diversity of breeding migratory insectivorous birds, valley forest/gully woodland bird census: Dulcet Gully, Willis Nature Reserve.** Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot contained a 500 m transect of 40 m width and stretched from the south side of the Smiths Gully Creek opposite Dulcet Gully (300 m upstream of the Peter Franke Reserve), across the creek and up Dulcet Gully. The plot was situated amongst one of the most diverse and intact valley forest/gully woodland assemblages in NEM.

Degree of fragmentation: low (all sides connect bushland; farmland is present 500 m to the south and west). Degree of thinning: medium (tree density of 210/ha; extensive sapling and shrub regeneration from logging and fires). Degree of understorey and ground degradation: low (intact shrub and herb layers; dense shrubs along the creek and in Dulcet Gully and dense stands of fire regrowth Burgan and Black Wattle on the exposed slopes of Dulcet Gully).

Vegetation. Yellow Box–Candlebark valley forest (31.1 between Smiths Gully Road and the creek and along the eastern side of Dulcet Gully, and a band of Messmate–Mountain Swamp Gum gully woodland (10.2) in the sheltered Dulcet Gully and along Smiths Gully Creek. Adjoining habitats included Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes of Dulcet Gully. Trees/ha (25% cover): 54 Mountain Swamp Gum, 44 Yellow Box, 40 Red Stringybark, 22 Candlebark, 20 Long-leaf Box, 20 Red Box and 10 Narrow-leaf Peppermint. Tall shrubs (20% cover); low shrubs (10% cover); herbs (50% cover).

Results. Bird summary: 55 species and 921 individuals recorded (26 forest, 10 woodland, 17 shrubland and 2 fragmentation species); 46.1 birds/ha composed of 27.5 (60%) forest, 3.1 (7%) woodland, 14.6 (32%) shrubland and 0.9 (2%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (6.2), Buff-rumped Thornbill (3.4), Spotted Pardalote (2.9), White-naped Honeyeater (2.5), Rufous Whistler (1.8), Weebill (1.3), Yellow-faced Honeyeater (1.3), Crimson Rosella (1.0), White-throated Treecreeper (1.0), Varied Sittella (0.9), Grey Currawong (0.6), Gang-gang Cockatoo (0.5) and Red-browed Treecreeper (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (1.1), Fan-tailed Cuckoo (0.5), Leaden Flycatcher (0.5) and Speckled Warbler (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (3.0), Silveryeye (1.9), Grey Fantail (1.7), Golden Whistler (1.7), Brown Thornbill (1.4), White-browed Scrubwren (1.2), Red-browed Firetail (0.9), White-eared Honeyeater (0.9), Eastern Yellow Robin (0.8), Grey Shrike-thrush (0.8) and Eastern Spinebill (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Common Blackbird (0.7)

Parrots: 3 species and 1.7 birds/ha. **Canopy insectivores–migratory:** 10 species and 2.1 birds/ha; **non-migratory:** 8 species and 18.9 birds/ha

Discussion: 46.1 birds/ha, 21.0 (45%) of which were tree canopy insectivores (dieback control agents). Fragmentation species were at low levels. Only five Bell Miners were recorded on the plot from the 10 combined counts of October 1989/90. A large colony existed a few hundred metres downstream at the Peter Franke Reserve. Since the surveys of 1989/90, the colony, having removed the canopy foliage cover from the Franke Reserve, moved upstream to Dulcet Gully. By autumn 1993, severe leaf defoliation of Mountain Swamp Gums and Narrow-leaf Peppermints had occurred and canopy insectivore populations had declined substantially.

The Dulcet Gully plot had a high level of shrubland birds (14.4 birds/ha). Of these, the Olive Whistler and Bassian Thrush were recorded breeding. The only other plot of 16 with either breeding was on Watsons Creek. The plot contained a nesting pair of Leaden Flycatchers (migratory canopy insectivore) in each census year. The non-migratory canopy insectivores (Striated Thornbill, Buff-rumped Thornbill, White-naped Honeyeater and Spotted Pardalote), were four of the five most common birds on the plot. This was a major reason why leaf psyllid and skeletoniser damage was low (compared with the Peter Franke Reserve plot).

Conclusion. Diverse and viable canopy insectivore populations and low rate of eucalyptus dieback.

Dc **83^c: High mammal diversity of the Smiths Gully Creek.** Twenty-four native mammal species were recorded in the southern section of the Willis Nature Reserve and Smiths Gully Creek/Peter Franke Reserve area. There are strong representations of bats (9 species), arboreal fauna (7 species) and ground fauna (8 species). This is second in diversity only to One Tree Hill in the upland hills and placed in the top five most diverse mammalian assemblages in NEM.

Other Significant Fauna

Birds

Eb **83^{bc}: Little Friarbird.** Two were seen amongst flowering Yellow Box (valley forest; 31.1) upstream of Peter Franke Reserve on 28 December 1987. Up to five birds were seen at the St Andrews market grounds on several occasions over the following weeks, and in late February 1988 a pair was seen on the Diamond Creek at Watts Lane Cottles Bridge in flowering Manna Gum (riparian forest; 5.3). There were only five other sightings of the Little Friarbird during the survey period and most were seen in the hills of NEM in the summer of 1987/88. The species had been an irruptive migrant over the previous decade, but was reportedly more common in the 1950s and 1960s.

During the inland drought of 1977/78 they were frequently seen in NEM, following seasonal flowering eucalypts. This included winter sightings in flowering Red Ironbarks (e.g. Long Gully Headwaters and Plenty Gorge Yarrambat). They are now only early summer to mid-autumn visitors and visit in much lower numbers. In the irruption of 1987/88 they arrived in early December for the flowering River Red Gum on the alluvial plains, moved over Christmas/New Year into the flowering Yellow Box in valleys of the hills (e.g. St Andrews) and stayed until late March for the flowering Manna Gum along the creeks.

Ec **83^c: White-throated Nightjar.** One was located on the exposed upper slopes of the ridgeline east of Dulcet Gully on 22 October 1989. The vegetation was Long-leaf Box–Red Stringybark box–stringybark

woodland (11.4). The nightjar was formerly widespread in the Nillumbik Upland and Lowland Hills but is now rare, being recorded at only five of the 23 sites.

Ec **83^C: Azure Kingfisher.** One was seen along the creek (10.2) near the Franke Reserve on 29 July 1989. The kingfisher apparently does not breed locally as there would appear insufficient invertebrate and fish prey in the stream. The nearest breeding locality was Arthurs Creek at Nutfield (site 66).

Ec **83^C: Cicadabird and White-throated Gerygone.** A Cicadabird was nesting on 28 December 1987 in Red Stringybark herb-rich foothill forest (6.1) on the sheltered hill-slopes above Peter Franke Reserve. They are spring-summer migrants to south-eastern Victoria from far northern Australia. In Victoria most records have been from the coastal and foothill forests of Central and East Gippsland. Melbourne represents the western end of their range. The bird was feeding amongst the canopy foliage and branches of Red Stringybarks and Blackwoods. They feed principally on invertebrates (particularly caterpillars) and are inconspicuous in behaviour and call. The White-throated Gerygone is also a spring migrant from northern Australia. They nested in the canopy of a tall Yellow Box (valley forest; 31.1) upstream of Peter Franke Reserve in December 1987.

Ec **83^C: Chestnut-rumped Heathwren.** Several breeding pair were seen in Yellow Box–Candlebark valley forest (31.1) on 22 October 1989 amongst thickets of Black Wattle, Burgan and Austral Bracken (post-1962 bushfire) on the eastern side of Dulcet Gully at Willis Nature Reserve. This was one of only three localities recorded for the species in the foothills of NEM. Each location contained 1962 fire regrowth Black Wattle and Burgan. At the Willis Nature Reserve, the dense stands of Burgan are over-topped by senescing Black Wattles. The ground is strewn with fallen branches and contains dense stands of Weeping Grass, Kangaroo Grass and Common Wheat-grass. Low shrubs, apart from Spreading Wattle and bracken, are scarce.

83^C: wintering damp mountain forest birds from the ranges. The Pink Robin, Flame Robin, Eastern Whipbird and Spotted Quail-thrush visit between mid-autumn and early spring. These species were seen on 27 July 1989 on a walk between Proctor Street ford and Peter Franke Reserve. They are non-breeding wintering migrants from the ranges and were not recorded in the October valley forest/gully woodland census. In addition to the preceding birds, several other species including the Olive Whistler, Bassian Thrush and Crescent Honeyeater also visit from the ranges during winter. Small numbers are also resident, as each was recorded breeding in Dulcet Gully in the October valley forest/gully woodland census.

The Pink Robin visits groves of Silver Wattle along the creek and occasionally the regrowth areas of Black Wattle and Burgan on the hill-slopes. The Flame Robins visit open sections such as Hi Clear, above Black Cameron Mine. The extensive areas of tussock-grass habitat and tall shrub thickets of the Willis Reserve form important wintering areas for the Spotted Quail-thrush. The quail-thrush had been seen previously near Proctor Street ford in autumn 1988 (Pat Vaughan pers. comm.).

The Eastern Whipbird was seen along the creek, but does not appear to breed locally (the only confirmed breeding locality in the foothills is Watsons Creek near the junction of Happy Valley Creek, site 64). They bred in the area in the 1970s. Since that time, Common Blackbirds and Bell Miners have invaded the valleys and together pushed out the breeding population. Breeding whipbirds are particularly vulnerable to cats, which have also increased in the area.

The links to One Tree Hill along Smiths Gully Creek and overland via The Knobs to Yow Yow Creek and Kinglake NP are important in maintaining genetic exchange between the mountain and foothill populations of these species. The links facilitate seasonal or migratory movements, juvenile dispersal and local expansions in foraging range of mountain birds into the foothills during autumn-winter. Recruitment into the site is crucial for the maintenance of resident populations of breeding species and other gully birds including the Red-browed Treecreeper.

83^C: Nankeen Night Heron. A juvenile was seen at a dam in the headwaters of a gully in the eastern section of Willis Reserve in late December 1991.

83^c: Valley Forest/gully woodland bird census: Peter Franke Reserve. Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot consisted of a 200 m by 100 m rectangle centred on a Bell Miner colony in the Peter Franke Reserve.

Degree of fragmentation: low but immediately abutting farmland to the west. Degree of thinning: high (tree density of 140/ha; formerly cleared for the St Andrews Battery and opened up by Smiths Gully Road and tracks into the reserve). Degree of understorey and ground degradation: high (Blackberry along the gully and Montpellier Broom and alien grasses in the reserve).

Vegetation. Strips of Yellow Box valley forest (31.1) on the north-facing valley and Messmate–Swamp Gum gully woodland (10.2) in an exposed gully above Smiths Gully Creek. Messmate–Mountain Swamp Gum gully woodland (10.2) was present nearby along the creek. Trees/ha (20% cover): 66 Narrow-leaf Peppermint, 38 Swamp Gum, 10 Yellow Box, 16 Candlebark and 10 Red Box. Tall shrubs (10% cover); low shrubs (20% cover); herbs (60% cover).

Results. Bird summary: 49 species and 432 individuals recorded (16 forest, 9 woodland, 12 shrubland and 11 fragmentation species); 21.6 birds/ha composed of 3.4 (16%) forest, 1.3 (6%) woodland, 4.7 (22%) shrubland and 12.2 (56%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the White-naped Honeyeater (0.8) and Grey Currawong (0.7)

Woodland species with densities exceeding 0.5/ha included the Eastern Rosella (0.7)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (1.8), White-browed Scrubwren (1.2) and Eastern Yellow Robin (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Bell Miner (9.0), Australian Magpie-lark (0.6) and Common Blackbird (0.5)

Parrots: 4 species and 1.0 bird/ha. **Canopy insectivores–migratory:** 6 species and 0.4 birds/ha; **non-migratory:** 6 species and 1.7 birds/ha

Discussion. 21.6 birds/ha, 2.1 of which were tree canopy insectivores (dieback control agents). The census was dominated by the Bell Miner (44% of all recorded birds). As a result, about two-thirds of the trees (nearly all the Narrow-leaf Peppermints and most of the Swamp Gums) were sustaining leaf psyllid and skeletoniser damage and tree dieback. About 20% of the trees had advanced dieback. Forest and woodland birds, apart from nesting pairs of Grey Currawongs and Eastern Rosellas, were virtually all passage sightings. The dieback control insectivores were invariably recorded while being harassed by the miners. Shrubland birds such as the Golden Whistler and White-eared Honeyeater, which also utilise trees, were rare.

There was a presence of aggressive farmland birds (e.g. Australian Magpie-lark). Species which keep to cover, such as the Superb Fairy-wren and White-browed Scrubwren, managed to co-exist with the miners. The level of defoliation caused to the eucalypts has been so severe that in 1992, most of the Bell Miner colony moved upstream to the sheltered slopes of Dulcet Gully.

Conclusion. The Bell Miner colony has led to depauperate insectivore diversity and heavy eucalyptus dieback.

Mammals

Ec **83^c: Long-nosed Bandicoot.** Seen while spotlighting in Dulcet Gully on the Willis Nature Reserve on 27 February 1993. Diggings were observed under Red Stringybark herb-rich foothill forest (6.1) in February 1992. These were amongst the Spiny-headed Mat-rush and Common Maiden-hair herbfields above the Smiths Gully Creek on the neighbouring Sanders block, toward Black Cameron Road. Bandicoots have been seen periodically crossing Smiths Gully Road west of Spanish Gully Road (David Hespe pers. comm.). Speeding cars present a threat to the bandicoot, while Common Wombats and Black Wallabies are frequent road-kills along the section of the road running adjacent to the creek. Enhancing habitat links and placing controls on wandering domestic cats in the site may be critical for the survival of this species.

Ed **83^c: Feathertail Glider.** A colony was present in a large Candlebark (31.1) along Smiths Gully Road near the front of Queenstown Cemetery, when it was felled by SEC linesmen in August 1987 (Kahn Franke pers. comm.). One was seen in Dulcet Gully on the Willis Reserve while spotlighting on 27 February 1993.

Ed **83^c: Mountain Brushtail Possum.** One was seen in Dulcet Gully on 27 February 1993. The range of the Mountain Brushtail is mainly restricted to the ranges, but enters the upland hills between St Andrews and Christmas Hills. The continuity of habitat links to Kinglake NP may be crucial for the survival of foothill populations. Bushland fragmentation has enabled the Common Brushtail Possum to replace the Mountain Brushtail Possum in the upland hills. The latter persists only where pockets of Messmate-Mountain Swamp Gum gully woodland (10.2) surrounded by large stands of Messmate herb-rich foothill forest (6.3) have been retained (e.g. Willis Reserve and One Tree Hill).

Ed **83^c: Gould's Long-eared Bat.** This was one of six species trapped on 21 November 1990 at a dam on a saddle in the eastern section of Willis Nature Reserve. Vegetation on the nearby sheltered slopes is Messmate-Narrow-leaf Peppermint herb-rich foothill forest (6.3). There are Mountain Swamp Gums present on the lower slopes. Seventeen bats, including one female Gould's Long-eared Bat, were taken from the single harp trap placed under overhanging trees on the edge of the water. The Gould's Long-eared Bat is predominantly an upland gully species in GM and was most often trapped in Mountain Grey Gum or Messmate damp sclerophyll forest (4.1/4.2) and Mountain Ash wet forest (2.1) in the ranges.

83^c: Koala. A resident population (perhaps 6–10 animals) occurs along Smiths Gully Creek. This is one of the largest populations in NEM away from the Yarra River at Warrandyte. The Koala (males in particular) is known to move long distances. It is likely that interchange of animals occurs between this population and those along the Yarra and in Kinglake NP. Watsons Creek serves as the main corridor. Koalas move from Smiths Gully Creek in the vicinity of the Peter Franke Reserve overland to the Long Gully Creek headwaters near Clintons Road and down through the Long Gully link to Watsons Creek and Yarra River.

Reptiles

Ee **83^c: Red-bellied Black Snake.** This species has been recorded in the upland hills only near streams away from human habitation. It has declined with settlement and is very scarce in the lower reaches of the Diamond Creek. The sighting was made on 22 October 1989 near the junction of Dulcet Gully and Smiths Gully Creek on the Willis Reserve.

Butterflies

Df **83^b: Lower Smiths Gully Creek and Willis Nature Reserve.** Twenty-eight species recorded from nine searches. An additional species (Flame Skipper) was recorded by Michael Braby from the Smiths Gully Creek, upstream of St Andrews market grounds in December 1991. The diverse habitat and topography of the Willis Nature Reserve, ranging from a stream and damp foothill gullies, through exposed hill-slopes to open, grassy hill-crests support a diverse butterfly assemblage. The scattered trees on the ridgeline and treeless stands of Burgan on Hi Clear, east of the Black Cameron Mine, form a butterfly hill-topping area. The sheltered hill-slopes contain Messmate herb-rich foothill forest (6.3). Sedgeland and fernlands occupy upper Dulcet Gully and the sheltered gullies of Smiths Gully Creek toward Proctor Street.

Significant species:

- Spotted Skipper: larvae found on Thatch Saw-sedge (6.3) in the headwaters of Dulcet Gully on 27 February 1993
- Donnysa Skipper: adults feeding in flowering Burgan (6.3) in the headwaters of Dulcet Gully on 21 November 1990; likely breeding in Thatch Saw-sedge
- Flame Skipper: several recorded (31.1) in December 1991 from near Smiths Gully Creek upstream of St Andrews market grounds (Michael Braby pers. comm.); likely breeding in Thatch Saw-sedge. One Tree

- Hill, the Smiths Gully Creek and nearby sections of the Diamond Creek are the only areas in the upland hills where this mountain species has been recorded; it also occurs in the Yarra Lowland Hills in NEM
- Bright Shield Skipper: several seen hill-topping at Hi Clear in March 1993; breed on Slender Tussock-grass in upper Dulcet Gully
 - Symmomus Skipper: breed in Spiny-headed Mat-rush above Smiths Gully Creek between the market area and Proctor Street ford; widespread
 - Common Imperial Blue: breeds on Hillslope Silver Wattle and dwarf Blackwood (31.1) on the escarpment of the creek
 - Dark Purple Azure: an adult laying eggs on the branches of a Creeping Mistletoe in a Red Box (11.1) above Proctor Street ford on 27 October 1990; the larvae feed on the foliage of the mistletoe at night, attended by a small black ant (*Crematogaster* sp.); larvae were located on 10 December 1990 sheltering close to the mistletoe under loose bark on a limb of the eucalypt
 - Olane Azure: several hill-topping and feeding on nectar in flowering Box Mistletoe (on Long-leaf Box; 11.4) at Hi Clear in March 1993; a female was laying eggs
 - Cyril's Brown: 10 or more adults hill-topping at Hi Clear in October 1990; likely breeding in Grey Tussock-grass on the sheltered slopes (6.3)
 - Spotted Brown: a substantial breeding population on Slender Tussock-grass (10.2) in upper Dulcet Gully on 27 February 1993
 - Bank's Brown: breeding on Sword Tussock-grass (10.2) in a gully near Smiths Gully Creek about 500 m upstream of Proctor Street ford in April 1993

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Bushblock housing advance and habitat degradation. The period since the mid-1970s has seen at least a two-fold increase in housing and subdivision density in the site. A decline in the quality and quantity of the understorey habitat has resulted. Further subdivision will continue these trends.</p>	<p>Habitat connectivity. Strategic Habitat Link. Intact links to the Cottles Bridge to St Andrews site, Yow Yow Creek site, Kangaroo Ground Red Ironbarks site and Long Gully Link site. Fragmented links to the One Tree Hill–Watsons Creek Link site and Diamond Creek Upper Reaches site. The site links six other foothill sites of significance and is the radial centre of riparian links in the Nillumbik Upland Hills. These link between the watersheds of the Diamond and Watsons Creeks and the overland link at One Tree Hill between the Yarra and Kinglake NP. The Smiths Gully site is critical for faunal movement between Kinglake NP and the Diamond Creek. It contains habitat nodes (e.g. Willis Nature Reserve) which support viable and diverse stands or breeding populations of lowland and upland flora and fauna species. Strengthen strategic habitat link.</p>

 Regional Hydrological Strategy

<p>Streamway degradation of Smiths Gully Creek. The water quality and instream fauna diversity in the lower reaches of the creek is poor and declines appreciably downstream of Proctor Street ford. The water in this section is odorous from wastewater runoff and septic tank leachate. Runoff from tracks and roads has raised the level of water turbidity. The problem seems exponentially related to increasing housing density.</p>	<p>Require long-term improvement in water quality of Smiths Gully Creek. Native vegetation in the streamway (area 100 m to either side of the Smiths Gully Creek and its major tributaries) must be protected. The streamway needs to be protected from livestock grazing. Fencing to exclude livestock would be required to revegetate upstream sections of the creek. The conservation of all native flora and fauna species in the site would require that all bushland be protected. Given the low rate of stream flow due to farm dams, household wastewater and livestock pollute the creek. Severe domestic pollution sources should be located and rectified. Further dams in the catchment will lower the flow rates and magnify the water quality problem. A marked improvement in water quality to the point where the creek again supports native instream vertebrate fauna will require commitment and co-operation of all landowners in the catchment. An active public awareness exercise is needed.</p>
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 Other Issues

<p>Weeds along Smiths Gully Creek. Several environmental weeds are widespread in the bushland as well as near settlement along the lower section of Smiths Gully Creek. These include Blackberry, Montpellier Broom, Spanish Heath, Boneseed, Large Quaking-grass and Sweet Vernal-grass. Blue Periwinkle, Japanese Honeysuckle and Tutsan are expanding. Areas of high disturbance and nutrient enrichment near the St Andrews market grounds contain Bulbil Watsonia, English Ivy, Wandering Jew, Bridal Creeper and Three-cornered Garlic (Angled Onion). The creek in this area is unattractive and degraded, a result of years of disturbance. Horse riding and pedestrian trampling occurs in the streamway near the St Andrews market grounds.</p>	<p>Smith Gully LandCare group. LandCare involves land protection, weed control and revegetation programs on private land. The area under management contains significant flora and fauna and is a strategic habitat link between One Tree Hill and the Diamond Creek. The most important issue is improvement of this link. The group needs to focus activities on the significant streamway sections, particularly areas connecting the Willis Nature Reserve and Peter Franke Reserve. It is essential that time and resources are invested into protecting the most intact bushland. Incentives should be provided to property owners to undertake these activities.</p> <p>Conservation covenants. The site contains a nucleus of blocks with conservation covenants. Negotiating further covenants or similar conservation agreements and undertaking conservation management on adjoining properties would consolidate biological values. These should be accompanied by the development of a habitat protection incentive scheme. Covenants would require specific, conditional and pro-active clauses regarding the protection of fauna and faunal habitat values. The purpose and benefits of covenanting should be promoted to all landowners within or adjoining the site.</p>
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Weeds at St Andrews Wildflower Reserve environs. Weeds include Montpellier Broom, Spanish Heath, Boneseed, Blackberry, Monterey Pine and Sweet Pittosporum. Large Quaking-grass and Brown-top Bent are invading the bushland from the disturbed edges.

Willis Nature Reserve. The reserve requires a land conservation management plan. Key issues to address include ascertaining the appropriate level (if any) of public usage. If opened to the public, prohibition of non-passive uses such as horse riding and trail-bike riding needs to be enforced. The reserve has undergone a long and significant healing process from past land-use. The covenant implicitly states that future land-use activities which compromise the flora and fauna values are to be excluded. The reserve could be used for nature education. This would need to be developed in conjunction with interpretational facilities. Works priorities should include the control of weeds (particularly Spanish Heath) and land protection activities such as revegetating disturbed areas near the Black Cameron Mine.

The reserve is not currently grazed by livestock. It is important that the reserve is managed in such a way as not to be a fire hazard to adjoining properties. The level of growth in wet years such as 1992 and advance of the combustible Burgan should be monitored. Floristic reference plots would assist in the monitoring. The kangaroo, wallaby and rabbit populations assist in keeping the grass and shrub fuel loads down. The reserve contains extensive stands of significant habitat. Protecting these is the most immediate management priority.

St Andrews Wildflower Reserve. The public land block to the west of the Kangaroo Ground–St Andrews Road should be incorporated into the wildflower reserve. It contains fine stands of Red Stringybark herb-rich foothill forest and Yellow Box–Candlebark valley forest and many regionally and locally rare or threatened orchid species. The perimeter of both areas adjoining the main road and the land to the north fronting the main road to the market grounds require weed control programs.

Site 84 Yow Yow Creek–Wild Dog Creek

- Map Reference:** 7922 483377 to 7922 509369 (Yow Yow Creek); 7922 485388 to 7922 509377 (Wild Dog Creek); 7922 497367 (Cant and Couties Mine/The Knobs); 7922 487372 (Yow Yow Creek electrofishing site); 7922 496374 (Yow Yow Creek valley forest/gully woodland bird census mid-point); 7922 497386 (Wild Dog Creek valley forest/gully woodland bird census mid-point). One minute lat/long grids include 37° 35' x 145° 17' to 145° 18' and 37° 36' x 145° 17'.
- Location/Size:** Lower and middle reaches and intervening areas of the Yow Yow and Wild Dog Creeks abutting Kinglake NP, north-east of St Andrews. Approximately 450 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Public Land Water Frontage (K1, LCC 1977; Yow Yow Creek for the full length of the site and Wild Dog Creek between the Diamond Creek and Kinglake NP. Private: some of the bushland has regenerated from previous clearing. Farms and farmlets (generally of horses and cattle) of 8 to 20 ha and some stud properties occur to the east of the site in the upper Yow Yow Creek. Much of the site is composed of approximately 8 ha bushblocks.
- Landforms:** Foothill (see NUH B). Elevation is 145–310 m.

Scientific and Educational Values

Scientific reference. Yow Yow Creek upstream of the end of Yow Yow Creek Road and Wild Dog Creek adjacent to Kinglake NP form valley forest/gully woodland census plots. Electrofishing site and instream reference point in Yow Yow Creek at the corner of Yow Yow Creek Road and Butterman Track.

HABITAT SIGNIFICANCE

Assessment: High–Category 2

Reference stands: Manna Gum gully woodland (10.1)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); ; Messmate–Mountain Swamp Gum gully woodland (10.2); Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Messmate herb-rich foothill forest (6.3)

Vulnerable species: Wine-lip Spider-orchid

Critical assemblages or populations: Strategic Habitat Link. Box–stringybark woodland orchid flora; Manna Gum gully woodland of Yow Yow Creek

FAUNAL SIGNIFICANCE: Site 84 Yow Yow Creek–Wild Dog Creek

Assessment: State–Category 3 (B, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

84^a: 37° 35' x 145° 17'; Wild Dog Creek/Dinsdale Road–Yow Yow Creek

84^b: 37° 36' x 145° 17'; The Knobs/Cant and Couties Mine, Butterman Track

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. 84^a: Breeding female Eastern Horseshoe Bat trapped on Yow Yow Creek on 20 November 1990

c. Rare fauna

State. 84^a: Barking Owl, Brush-tailed Phascogale, Common Dunnart, Common Bent-wing Bat, Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 84^a: 9 species including the Sacred Kingfisher, Brush Cuckoo, Black-eared Cuckoo, Leaden Flycatcher and Satin Flycatcher at Yow Yow Creek census plot in October 1990; 8 species including the Sacred Kingfisher, Leaden Flycatcher and White-throated Gerygone at Wild Dog Creek census plot in October 1989

h. Bats

Regional. 84^a: 6 species including the Common Bent-wing Bat at Yow Yow Creek on 25 November 1989; 5 species including the Gould's Long-eared Bat and Eastern Horseshoe Bat at Yow Yow Creek on 20 November 1990

Regional. 84^b: 5 species at The Knobs on 23 November 1989

i. Arboreal mammals

Regional. 84^a: 4 species including the Koala and Sugar Glider along Yow Yow Creek on 25 November 1989

j. Ground mammals

Regional. 84^b: 5 species including the Bush Rat at The Knobs on 21 May 1989

k. Frogs

Regional. 84^a: 6 species including the Victorian Smooth Froglet along Yow Yow Creek on 25 November 1989

l. Reptiles

Regional. 84^a: 6 species including the Tree Dragon, Weasel Skink and Southern Water Skink along Yow Yow Creek on 25 November 1989

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 84^a: 105 species

b. Native birds

Regional. 84^a: 71 species

c. Native mammals

Regional. 84^a: 20 species including 9 species of bats

Regional. 84^b: 13 species

d. Herpetofauna

Regional. 84^a: 14 species

Regional. 84^b: 8 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 84^a: 14 species

b. Regionally endangered fauna (R1 species)

Regional. 84^a: 1 species. **Mammals:** Eastern Horseshoe Bat

c. Regionally vulnerable fauna (R2 species)

State. 84^a: 7 species. **Birds:** Barking Owl, White-throated Nightjar, Black-eared Cuckoo. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Common Bent-wing Bat. **Reptiles:** Tree Goanna

Regional. 84^b: 1 species. **Mammals:** Common Bent-wing Bat

d. Regionally rare fauna (R3 species)

Regional. 84^a: 3 species. **Birds:** Collared Sparrowhawk, Spotted Quail-thrush. **Mammals:** Gould's Long-eared Bat

Regional. 84^b: 2 species. **Reptiles:** Eastern Small-eyed Snake, White-lipped Snake

e. Regionally depleted fauna (R4 species)

Regional. 84^a: 3 species. **Birds:** Leaden Flycatcher, Speckled Warbler. **Fish:** Mountain Galaxias

Local. 84^b: 1 species. **Birds:** Speckled Warbler

f. Regionally restricted fauna (R5 species)

Regional. 84^a: 9 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** McCoy's Skink

g. Nesting birds of prey

Regional. 84^a: Collared Sparrowhawk at Yow Yow Creek census plot in October 1989

F. POPULATION DENSITY: Viability and Abundance–point census

g. Rare/restricted colonial fauna

State. 84^a: over 50 Common Bent-wing Bats seen leaving the eastern entrance of Yow Yow Creek Mine on 25 November 1989; six were trapped at the western entrance

Regional. 84^b: 2 Common Bent-wing Bats trapped at the entrance of Cant and Couties Mine on 26 November 1989

i. Bat trapping rate

Regional. 84^a: trap-night average of 10 bats at Yow Yow Creek on 20 November 1990

n. Regionally depleted fauna (R4 species)

Regional. 84^a: about 20 Mountain Galaxias in the pools of the lower Yow Yow Creek on 27 November 1989

Outlook

The faunal significance may decline if the rate of bushblock housing density and habitat degradation increases. Habitat enhancement works such as weed control and improvement of habitat links are required.

FAUNA

Rare or Threatened Fauna

Bb 84^a: Breeding Eastern Horseshoe Bat. A female with a newborn under-wing was trapped in the bed of Yow Yow Creek on 20 November 1990. The female possibly bred in the nearby Yow Yow Creek Mine. This is the only confirmed breeding observation in Victoria away from maternity colonies in natural caves in East Gippsland. They are known to transport bittens between roosts in northern Australia. As is the case for the Lesser Long-eared Bat, young accompany foraging mothers in the first week after birth. The population of over-wintering horseshoe bats recorded in One Tree Hill Mine may be linked with the Yow Yow Creek Mine.

Bc 84^a: Barking Owl. They have been heard on occasion at Dinsdale Road (Peter Tadich pers. comm.).

- Bc* **84^a: Brush-tailed Phascogale and Common Dunnart.** Both were trapped along the proposed Gas and Fuel Pipeline between Dinsdale Road and Yow Yow Creek in 1981. The phascogale was taken in a cage trap set in a fork of a Long-leaf Box, 5 m above ground. The dunnart was taken on the ground in an Elliott trap. Phascogales were seen previously (Marlene Pugh pers. comm.) and later in the 1980s (Peter Tadich pers. comm.). Trapping was not conducted for either species during the survey as both were considered still likely to be present. The surrounding vegetation of Red Box–Red Stringybark box–stringybark woodland (11.1) and Red Stringybark herb-rich foothill forest (6.1) is typical of that required by both species.
- Bc* **84^a: Tree Goanna.** One was seen at Wild Dog Creek Road in early 1989 (David Munday pers. comm.).
- Bc* **84^a: Mountain Galaxias.** About 20 in the pools of the lower Yow Yow Creek on 27 November 1989.

Critical Assemblages or Populations

- Fg* **84^a: Common Bent-wing Bat.** They were recorded in the Yow Yow Creek Mine and the Cant and Couties Mine at The Knobs. Over 50 bats were seen leaving vertical shafts in the bank of the creek and on the ridge of the Yow Yow Creek Mine on 25 November 1989. Six males were trapped. The mine contained the fourth largest population of bent-wing bats recorded in NEM during the study. The wintering population may be larger as it likely includes females.

Two Common Bent-wing Bats were trapped outside Cant and Couties Mine on 26 November 1989. None were recorded leaving the mine on a dusk watch in late December, suggesting intermittent usage. Droppings, presumably of bent-wing bats, were located in the drive of another local mine.

Other Significant Fauna

Birds

- Ec* **84^a: Black-eared Cuckoo.** This species was recorded in Yellow Box Candlebark valley forest (31.1) at the Yow Yow Creek bird census plot on 15 October 1990, one of only a half dozen records of this species in NEM. The Black-eared Cuckoo is a summer migrant to Victoria from northern Australia. The main population occurs in the semi-arid box–ironbark woodlands of northern Victoria and mallee shrublands of the north-western deserts. Only small numbers enter southern Victoria, where they are mainly recorded in dry woodland habitats supporting a prominent layer of tall shrubs such as wattles.

84^a: Mountain forest birds along Yow Yow Creek fauna link to Kinglake NP. Non-breeding flocks of Yellow-tailed Black-Cockatoos are frequently seen moving along Yow Yow Creek. The Collared Sparrowhawk was breeding during the bird census of October 1989. Canopy avifauna provide the main diet of this species. The sparrowhawk is more common in the upland hills and ranges than in the lowland hills and plains in NEM. It is most often recorded along streams containing extensive forest frontages.

84^a: Valley forest/gully woodland bird census: Yow Yow Creek. Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot consisted of a 500 m transect 40 m wide along the south side of the Yow Yow Creek, commencing immediately upstream of the end of Yow Yow Creek Road. The plot was in over 100 ha of forest.

Degree of fragmentation: low (one side connected to farmland, three sides to bushland). Degree of thinning: low (tree density of 330/ha; heavy regeneration from mining, logging and fires). Degree of understorey and ground degradation: medium (intact shrub layers and ground pitted by alluvial mining but not heavily weed invaded). The riparian vegetation was in good condition.

Vegetation. Band of Yellow Box–Candlebark valley forest (31.1) in the valley of the creek. Bordered by Red Box–Red Stringybark box–stringybark woodland (11.1) on the north-facing hill-slopes above the creek and Manna Gum gully woodland (10.1) along the creek. Trees/ha (30% cover): 100 Red Box, 90 Red Stringybark, 30 Messmate, 30 Narrow-leaf Peppermint, 20 Long-leaf Box, 20 Yellow Box, 20 Manna

Gum, 10 Candlebark and 10 Mountain Swamp Gum. Tall shrubs (20% cover); low shrubs (20% cover); herbs (50% cover).

Results. Bird summary: 58 species and 912 individuals recorded (27 forest, 11 woodland, 17 shrubland and 2 fragmentation species); 45.6 birds/ha composed of 26.4 (58%) forest, 4.2 (9%) woodland, 14.6 (32%) shrubland and 0.4 (<1%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (6.7), Spotted Pardalote (2.7), Weebill (2.4), Buff-rumped Thornbill (2.4), White-naped Honeyeater (1.9), Rufous Whistler (1.7), White-throated Treecreeper (1.6), Crimson Rosella (0.9), Yellow-faced Honeyeater (0.8), Red-browed Treecreeper (0.7), Brown-headed Honeyeater (0.7), Varied Sittella (0.6), Sacred Kingfisher (0.6), Yellow-tailed Black-Cockatoo (0.5) and Shining Bronze-Cuckoo (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (1.9), Laughing Kookaburra (0.5) and Fan-tailed Cuckoo (0.5)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (3.6), Grey Fantail (2.6), White-browed Scrubwren (1.9), Silveryeye (1.6), Brown Thornbill (1.3), Red-browed Firetail (1.0), Grey Shrike-thrush (0.9), Golden Whistler (0.8) and Eastern Yellow Robin (0.6)

Fragmentation species with densities exceeding 0.5/ha: nil

Parrots: 4 species and 1.5 birds/ha. **Canopy insectivores–migratory:** 11 species and 4.4 birds/ha; **non-migratory:** 8 species and 19.5 birds/ha

Discussion. 45.6 birds/ha, 23.9 of which were tree canopy insectivores (dieback control agents). There was a close similarity between the results of this plot and the Dulcet Gully, Willis Nature Reserve plot. Both were situated in extensive tracts of bushland and contained intact and extensive valley forest/gully woodland systems. The higher tree density provided by dense eucalyptus regrowth at Yow Yow Creek failed to attract additional canopy birds. Fragmentation species were particularly low at Yow Yow Creek. The Bell Miner was not present. There was a high level of shrubland birds (14.6 birds/ha).

The proximity of Manna Gums along the creek influenced the relatively high Striated Pardalote, Sacred Kingfisher and Red-browed Treecreeper counts. The Black-eared Cuckoo, Olive Whistler and Spotted Quail-thrush were each seen on one occasion. The Collared Sparrowhawk was breeding.

Conclusion. Diverse and viable canopy insectivore populations and low rate of eucalyptus dieback.

84^a: Valley forest/gully woodland bird census: Wild Dog Creek. Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot consisted of a 1000 m transect 20 m wide along the south side of the Yow Yow Creek. This commenced amongst freehold land 200 m west of the Kinglake National Park boundary, extended through the park, and finished at the park/freehold boundary to the east. The plot was flanked by an extensive (100 ha plus) stand of bushland. The western end took in the bushland strip along the creek and bordered cleared farmland to the north-west and bushblock housing to the north and south.

Degree of fragmentation: medium (two sides connected to farmland, two sides to bushland). Degree of thinning: low (tree density of 340/ha; mixture of regeneration from mining, logging and fires and mature trees). Degree of understorey and ground degradation: medium (open shrub layer along creek; habitat loss and disturbance from Wild Dog Creek Road; ground layer moderately weed invaded in farmland section and intact in national park section). The stream bank and channel were severely eroded.

Vegetation. Bands of Messmate–Swamp Gum gully woodland (10.2) along the creek flanked by Yellow Box–Candlebark valley forest (31.1) in the western section of the transect and Red Stringybark herb-rich foothill forest (6.1) in the eastern section. Trees/ha (25% cover): 140 Red Box, 60 Red Stringybark, 50 Long-leaf Box, 40 Yellow Box, 20 Candlebark, 20 Swamp Gum, 5 Messmate and 5 Narrow-leaf Peppermint. Tall shrubs (10% cover); low shrubs (10% cover); herbs (40% cover).

Results. Bird summary: 54 species and 829 individuals recorded (25 forest, 13 woodland, 12 shrubland and 3 fragmentation species); 41.5 birds/ha composed of 27.0 (65%) forest, 4.2 (10%) woodland, 9.8 (24%) shrubland and 0.5 (1%) fragmentation birds

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (6.9), Spotted Pardalote (2.9), Weebill (1.4), Buff-rumped Thornbill (2.5), White-naped Honeyeater (3.1), Rufous Whistler (2.0), Varied Sittella (1.5), White-throated Treecreeper (1.4), Crimson Rosella (0.9), Yellow-faced Honeyeater (0.8) and Brown-headed Honeyeater (0.6)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (3.8), Laughing Kookaburra (1.0) and Fan-tailed Cuckoo (1.0)

Shrubland species with densities exceeding 0.5/ha included the Superb Fairy-wren (7.1), Grey Fantail (5.2), White-browed Scrubwren (3.7), Silveryeye (3.1), Brown Thornbill (2.5), Red-browed Firetail (1.9), Grey Shrike-thrush (1.7), Golden Whistler (1.6) and Eastern Yellow Robin (1.1)

Fragmentation species with densities exceeding 0.5/ha (nil)

Parrots: 3 species and 1.5 birds/ha. **Canopy insectivores–migratory:** 11 species and 4.2 birds/ha; **non-migratory:** 9 species and 19.7 birds/ha

Discussion. 41.5 birds/ha, 23.9 (over 50%) of which were tree canopy insectivores (dieback control agents). With the exception of the shrubland birds there was a close similarity between the results of this plot and the Yow Yow Creek plot. The degradation of the Wild Dog Creek and proximity of Wild Dog Creek Road has reduced the shrub layers. The 10% difference in the bird count at Wild Dog Creek is mostly of shrubland birds. The cuckoos, which depend on shrubland birds to foster their young, were also down in numbers. The level of fragmentation species was low. The Bell Miner was not present.

The lack of Manna Gums and paucity of riparian wattles influenced the rarity of the Sacred Kingfisher and Red-browed Treecreeper and absence of the Brush Bronzewing and Rufous Fantail. Brush Cuckoos were recorded toward the last census days of each year, indicating they are one of the last migratory birds to arrive. The Jacky Winter and White-plumed Honeyeater were recorded adjacent to farmland at the western end of the plot. The White-throated Nightjar flew through the plot near the intersection of Wild Dog Creek Road and Dinsdale Road from further up the hill on a dusk count (17 October 1989). The day had been very warm and the bird was moving to a pool in the creek for a drink.

Conclusion. Reduced diversity and viability of canopy insectivore populations. Requires improvement of riparian habitat links.

Mammals

Ed **84^a: Gould's Long-eared Bat.** One was trapped in the bed of Yow Yow Creek on 20 November 1990. The main range of the species in GM is in the ranges. Trapping records indicate an association with streams, reflecting the greatest incidence of tree hollows.

84^a: Koala. An adult female was seen in both years of the valley forest/gully woodland bird census along Yow Yow Creek. A small breeding population is present (see Smiths Gully Creek site).

Freshwater fish

84^a: Electrofishing Survey: Yow Yow Creek

Map reference. 7922 487372. **Altitude.** 150 m. **Survey date.** 15 April 1992 and 2 July 1992 (water quality and flow readings)

Vegetation. Instream: submerged and emergent herbfield. Bank: Manna Gum gully woodland (10.1; fair condition; woody and grassy weeds). Frontage: Red Stringybark herb-rich foothill forest (6.1) and Yellow Box–Candlebark valley forest woodland (14. 6); both fair condition with woody and grassy weeds

Physical Features:

Pools

Substrate. Silt, sand, cobble and gravel on sheet sandstone. The creek contained a chain of small pools and intervening dry cobble sections

Maximum size (mid-autumn). 1.5 m wide by 0.3 m deep by 10 m long

Riffles

Substrate. Pebbles, cobbles, gravel, sand and branches on sheet sandstone

Flow (mid-autumn minimum): Size. Isolated pools, no flow. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 1.5 m wide by 2 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 2.9 ML/day

Water quality

Autumn: Temperature. 17.0°C. **Conductivity.** 1120 ms. **Salinity.** 0 ppt. **Turbidity.** Clear

Winter: Temperature. 10.2° C. **Conductivity.** 57 ms. **pH.** 6.7. **Dissolved Oxygen.** 11.4 ppm. **Turbidity.** Cloudy

Fish Recorded During Survey

Native species numbers/status. Mountain Galaxias (1); likely breeding resident

Alien species numbers/status. Nil

Other comments. The alien crustacean, *Cherax destructor* was recorded. Land tenure: freehold bushland. About 20 Mountain Galaxias were observed in pools in the lower Yow Yow Creek on 27 November 1989. Only one was recorded in the pools during the electrofishing survey in April 1992. The creek had not flowed for several months and salinity was near the upper levels in which the species can survive. Mountain Galaxias move up from the Diamond Creek to spawn during high spring flows in the cobble and sand sections of Yow Yow Creek.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. Intact link to the Diamond Creek headwaters site, Smiths Gully site and Diamond Creek Upper Reaches site. The site contains diverse and viable stands of habitat and breeding populations of lowland and upland fauna.</p>	
<p>Partial severance of habitat links. Damp forest species including the Superb Lyrebird, Yellow-bellied Glider and Greater Glider would have occurred along the Yow Yow and Wild Dog creeks and streams throughout the Nillumbik Hills. These have been eliminated from the lowland hills by land clearing and habitat fragmentation. They persist in the upland hills in only small numbers in pockets of damp sclerophyll forest. Populations of species such as the Eastern Whipbird, Long-nosed Bandicoot and Swamp Rat have been greatly reduced.</p> <p>The avifauna near settlements is dominated by edge inhabiting species (e.g. aliens and Bell Miners). Habitat fragmentation has led to declining populations of foliage birds and uncontrolled populations of foliage insects. Dieback amongst Swamp Gums on the lower floodplains has resulted. Red Stringybarks on the damp slopes have also undergone dieback. Altered drainage patterns and Cinnamon Fungus activated by earthworks may be the cause.</p>	<p>Strengthen strategic habitat links. An effective plan must be devised for linking forest habitat between Kinglake and the Yarra and preventing further fragmentation (See Watsons Creek Upper Reaches–Yarra Ridge site).</p>
Regional Hydrological Strategy	
<p>Streamway degradation. Commencing in the gold mining era, the Wild Dog and Yow Yow Creeks have undergone a long history of impact from Europeans. Both creeks were left in a poor condition by the alluvial and reef mining operations. Settlement in the lower sections has led to further habitat loss and degradation. Roadways run along the south bank of both streams. Pasture lies above the north bank of Wild Dog Creek and there are houses along the streamway of the Yow Yow Creek.</p>	<p>Conservation works along the streamways of the Yow Yow and Wild Dog Creeks. Habitat degradation caused by land settlement in the streamways and catchments of the feeder streams has lowered the water quality and led to fauna loss in the Diamond Creek. The impact of further housing development on the streams must be fully assessed. Further dams in the catchment of the Yow Yow and Wild Dog Creeks would reduce the already low summer/autumn stream flows. Stock should be restricted from grazing the streamways.</p>

The kilometre of so of Wild Dog Creek upstream of the Diamond Creek contains some of the most severe tunnelling, gulying and bank slumping seen in NEM. The stream frontage has been invaded by Blackberry, Montpellier Broom, Bulbil Watsonia and Sweet Vernal-grass. Black Rats are abundant, replacing Bush Rats in all but the most intact sections. Part of the streamway of Wild Dog Creek upstream of the Kinglake National Park extension occurs on private land. Livestock have damaged the substrate and scrub and herbfield vegetation, causing water turbidity. The block has been cleared and the remaining trees (particularly Red Stringybarks) have been ringbarked by livestock. The surviving Swamp Gums in the streamway appear to be dying.

Electrofishing site: Yow Yow Creek.

Serious lack of summer–autumn flow. Bank erosion–slumping and gulying and tree and bank undercutting, largely due to alluvial mining and rabbits. Bell Miner dieback damage to Mountain Swamp Gums. Weed advance to downstream. Several goats were tethered adjacent to the creek, damaging the riparian vegetation.

Declining native fish populations. Lack of seasonal flow due to farm and bushblock dams and removal or degradation of riparian and streamway vegetation have led to the decline in Mountain Galaxias. Only one was recorded in April 1992 at the electrofishing point in the Yow Yow Creek. The water quality and summer flow rate of the section of Yow Yow Creek downstream of the Kinglake Road is very low and supports few native fish. Household effluent, rubbish dumping and livestock faeces over recent decades have caused a decline in water quality in the lower sections of both the Yow Yow and Wild Dog Creeks.

An important section of Wild Dog Creek occurs on private land north of Wild Dog Creek Road, upstream of the Kinglake NP extension. The floodplain contains Prickly Tea-tree and soaks dominated by sedges and ferns. These do not occur in the park downstream. They may contain Swamp Rats and Long-nosed Bandicoots. The landowner should be encouraged to undertake land protection activities.

Protection of Public Land Water

Frontages. Both the Yow Yow and Wild Dog Creeks contain strips of this land tenure. Rehabilitation works need to be undertaken.

Require formation of a community land protection group. A group similar to that formed for the Smiths Gully Creek, is required for the Yow Yow and Wild Dog Creeks. The group should focus activities on the streamways.

 Other Issues

Public access into Kinglake National Park. Trail-bike and horse riders illegally access off-track sections of the park from Wild Dog Creek Road. There is some firewood removal and rubbish dumping occurring in the Wild Dog Creek Road section of the park.

Safety grills over entrances to Yow Yow Creek Mine. The Yow Yow Creek Mine occurs on private property and is one of the most important cave-bat roosts in NEM. Entry through either shaft is considered dangerous. Disturbance of the bats could cause them to desert the roost. It is imperative that the vertical shafts are covered with sheets of heavy gauge reinforcement mesh. The squares in the mesh should be of sufficient diameter to allow the bats to pass comfortably through (around 20 cm). Collapse or back-filling of the Yow Yow Creek Mine could threaten the Common Bent-wing Bat population in NEM.

Native vegetation clearance controls on private land. All significant native vegetation within the site, particularly within streamways and adjacent to Kinglake National Park, must be protected.

NUH C STRATHEWEN

This management unit consists of one site of state faunal significance (site 86) and two of regional faunal significance (sites 85 and 87) and surrounding land that forms habitat links.

Map Reference: 7922 441438 to 7922 507427 (west to east point); 7922 471405 to 7922 477471 (south to north point).

Location/Size: The unit contains the upper reaches of Arthurs Creek from Strathewen to Kinglake NP and Chadds Creek from the Cottles Bridge–Strathewen Road to the national park. It also contains a block of significant bushland between Hewitts Road and Hildebrand Road on the Apted and Nink properties. Approximately 1540 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the foothills of the Eastern Uplands. The unit contains the transition from the higher and younger (Devonian) Kinglake Surface of the ranges in the north to the older (Silurian) surface of the lower foothills in the south. The Devonian rock formations in the ranges overlie Silurian formations. The northern foothills of the unit are tucked under the Kinglake Ranges. Arthurs Creek has formed a narrow valley and floodplain.

Landforms

Mountain: slopes, ridges, gullies, valleys and streams. Foothill: hill-crests, hill-slopes, gullies, valleys, streams and floodplains, stream confluence (Arthurs and Chadds creeks) and dams. Elevation is 150–420 m.

Hydrology

Arthurs Creek is a perennial third order stream as it leaves Kinglake NP. Due to dams and the uptake of water for irrigation in the Strathewen valley, the creek flow drops to about eight or nine months of the year by Beale Avenue. The creek pools stagnate over late summer/early autumn and the water quality appears to be the lowest of any major stream in non-urban parts of NEM.

After rain the creek becomes fast-flowing. The stream contains cobble and gravel riffles and sand bars. Undercut banks surround open water pools (< 1 m deep) with submerged logs and emergent snags. The creek channel is deeply scoured and the bank has undergone severe erosion. There is a thick layer of silt on the bottom of the pools, undoubtedly exacerbated by extensive land clearing of the lower catchment, past logging of the upper catchment, runoff from roadsides and other earthworks, and livestock grazing of the creek banks.

Rainfall: 700–850 mm.

Site 85 Arthurs Creek Upper Reaches

- Map Reference:** 7922 467427 to 7922 477480 (Arthurs Creek); 7922 445434 (mid-point of the Eagle Nest block); 7922 457453 (McKimmies block). One minute lat/long grids include 37° 31' x 145° 15' to 145° 16', 37° 32' x 145° 14' to 145° 15' and 37° 33' x 145° 14'.
- Location/Size:** Arthurs Creek from above the Chadds Creek confluence to Kinglake NP. Approximately 630 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage (full length of Arthurs Creek; NRE); small municipal reserves (Strathewen Reserve along Arthurs Creek near Beale Avenue and Strathewen Hall; Shire of Nillumbik). Private: farmland (orchards and livestock) and uncleared land (abutting the national park along the northern section of the unit and bushblocks in the Strathewen valley).
- Landforms:** Mountain and foothill (see NUH C). Elevation is 160–420 m.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point in Arthurs Creek at Beale Avenue Strathewen.

HABITAT SIGNIFICANCE

Assessment: Medium–Category 1

Relatively intact and extensive stands: Manna Gum (creek) riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Messmate gully woodland (10.2)

Partially intact or small stands: Mountain Grey Gum damp riparian forest (3.1; upper Arthurs Creek); Mealy Stringybark heathy woodland (9.1)

Notable features: stand of Mealy Stringybark heathy woodland (9.1) on Chadds Creek Road

FAUNAL SIGNIFICANCE: Site 85 Arthurs Creek Upper Reaches

Assessment: Regional–Category 1 (B, C, D, E)

Reference grids for the significance keys include:

85^a: 37° 31' x 145° 15'; McKimmies land to Chadds Creek Road

85^b: 37° 31' x 145° 16'; Arthurs Creek/Chadds Creek Rd, Beale Ave to Johansons

85^c: 37° 32' x 145° 14'; Eagles Nest Road

85^d: 37° 32' x 145° 15'; Arthurs Creek/Chadds Creek confluence at Strathewen

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 85^b: Mountain Galaxias, Broad-finned Galaxias (present in 1982 and possibly still persists), Freshwater Blackfish

Regional. 85^a: Tree Goanna

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 85^d: 10 species including the Sacred Kingfisher, Rainbow Bee-eater, Black-eared Cuckoo, White-winged Triller, White-throated Gerygone, Rufous Songlark, Masked Woodswallow (breeding), and White-browed Woodswallow at the Arthurs Creek/Chadds Creek confluence on 13 November 1990

Regional. 85^b: 9 species including the Sacred Kingfisher, Brush Cuckoo and White-throated Gerygone along Arthurs Creek upstream of Beale Avenue on 14 November 1990

i. Arboreal mammals

Regional. 85^b: 4 species including the Koala and Sugar Glider along Arthurs Creek near Beale Avenue on 14 November 1990

j. Ground mammals

Local. 85^b: 4 species along Arthurs Creek near Beale Avenue on 14 November 1990

l. Reptiles

Local. 85^a: 4 species including the Tree Goanna and McCoy's Skink on McKimmies on 9 December 1991

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 85^b: 87 species

b. Native birds

Regional. 85^b: 67 species

c. Native mammals

Regional. 85^b: 8 species

d. Herpetofauna

Regional. 85^b: 9 species

e. Freshwater fish

Regional. 85^b: 3 species in Arthurs Creek near the north end of Chadds Creek Road: Short-finned Eel, Mountain Galaxias and Freshwater Blackfish

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 85^d: 9 species. **85^b:** 6 species.

c. Regionally vulnerable fauna (R2 species)

Regional. 85^d: 3 species. **Birds:** Azure Kingfisher, Black-eared Cuckoo, White-throated Gerygone

Regional. 85^b: 2 species. **Birds:** White-throated Gerygone. **Fish:** Freshwater Blackfish

Regional. 85^a: 1 species. **Reptiles:** Tree Goanna

d. Regionally rare fauna (R3 species)

Regional. 85^d: 2 species. **Birds:** Masked Woodswallow, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 85^b: 4 species. **Birds:** Australian King-Parrot, Eastern Whipbird. **Mammals:** Platypus. **Fish:** Mountain Galaxias

Regional. 85^d: 4 species. **Birds:** Australian King-Parrot, Rainbow Bee-eater, White winged Triller, Rufous Songlark

Regional. 85^a: 2 species. **Birds:** Superb Lyrebird, Eastern Whipbird

Regional. 85^c: 2 species. **Birds:** Superb Lyrebird, Bassian Thrush

f. Regionally restricted fauna (R5 species)

Local. 85^b: 6 species. **Birds:** Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, McCoy's Skink

Local. 85^a: 4 species. **Birds:** Brush Cuckoo, White-winged Chough. **Mammals:** Koala. **Reptiles:** McCoy's Skink

Local. 85^c: 2 species. **Birds:** Brush Bronzewing, White-winged Chough

Local. 85^d: 1 species. **Birds:** Red-browed Treecreeper

Outlook

The faunal significance may decline from Regional Category 1 to Category 2 due to severance of habitat links and increasing bushblock settlement.

FAUNA

Rare or Threatened Fauna

Bc 85^a: Tree Goanna at McKimmies. The Tree Goanna was seen at the rear of the McKimmies orchards on 9 December 1991. The species has not been recorded further west in the Running Creek Headwaters site and this location represents their western range limit in NEM.

Bc 85^b: Freshwater Blackfish. While not recorded during the electrofishing survey, Freshwater Blackfish, along with the Short-finned Eel, occur in the instream dam at Johansons, north of the end of Chadds Creek Road (Joe Shepherd pers. comm.). Blackfish do not appear to inhabit the stream (where the galaxias occurs) at Beale Avenue; it becomes reduced to shallow muddy pools in summer.

Bc 85^b: Broad-finned Galaxias and Mountain Galaxias in the Arthurs Creek headwaters. One Broad-finned Galaxias was recorded about 300 m north of Johansons bridge (1 km north of the end of Chadds Creek Road) in September 1982. A dam across Arthurs Creek about 500 m upstream of the north end of Chadds Creek Road has been stocked with trout. These run up to breed in the riffles as far as a series of waterfalls inside the boundary of Kinglake NP. Young trout probably eat galaxias eggs and fry. Mountain Galaxias occur in larger numbers in the headwater sections out of reach of the trout. The section of the creek about 1 km upstream from this area (where it leaves the national park on the north end of Johansons) was electrofished on 14 April 1992. No Broad-finned Galaxias were present but 37 Brown Trout were recorded. Six Mountain Galaxias were electrofished from Arthurs Creek at Beale Avenue on 14 February 1992.

The dam below Johansons is the major reason why trout survive in the stream. The trout is a predator and food competitor of galaxias. The Broad-finned Galaxias may be able to pass to breeding grounds in the headwaters of the creek, beyond the reach of the Brown Trout. However, they must first negotiate the poor water in the mid-reaches of the stream and then a 4 m high erosion cliff in a new course of the creek near the dam.

Other Significant Fauna

Birds

Ec 85^d: Azure Kingfisher. One was seen in remnant Yellow Box–Candlebark valley forest (31.1) near Strathewen Primary School in winter 1991 (Joe Shepherd pers. comm.). The kingfisher breeds along Arthurs Creek at Nutfield but appears to be a winter visitor to the upper section.

Ec 85^d: Black-eared Cuckoo and White-throated Gerygone. Both were observed in Manna Gum riparian forest (6.3). The Black-eared Cuckoo is a rare spring migrant. One was seen on 13 November 1990 near the Chadds Creek confluence at the road bridge picnic area. It was being harassed by Brown Thornbills

and White-browed Scrubwrens. The White-throated Gerygone was heard the same day in the Manna Gums along the creek.

Ed **85^d: Masked Woodswallow breeding in Manna Gums along Arthurs Creek.** The large Manna Gums near the Chadds Creek confluence support tree hollow nesting species. A pair of Masked Woodswallows bred in a Manna Gum spout downstream of the road bridge picnic area in November 1990. Another pair was breeding in a twig nest in a Silver Wattle. White-browed Woodswallows were also present but appeared to be mobile and not breeding locally. The Masked Woodswallow is a rare species in NEM (about 10 records) and was recorded breeding elsewhere only on the Plenty Volcanic Plains (site 15), Watsons Creek (site 64) and in the Plenty Gorge (site 40).

Despite migrating in joint flocks the two species of woodswallows often do not breed together. Along Arthurs Creek the Masked Woodswallow breeds in the upland hills (Strathewen) while the more common and widespread White-browed Woodswallow breeds in the lowland hills between Hurstbridge and Nutfield.

85^d: Rainbow Bee-eater and White-winged Triller. On 13 November 1990, one Rainbow Bee-eater was present near Arthurs Creek bridge at Strathewen. The species was likely breeding in the banks of the creek. A pair of White-winged Trillers was nesting in a Candlebark at Strathewen Hall (31.1).

85^{a-d}: Superb Lyrebirds, Australian King-Parrots and Eastern Whipbirds. These species breed in the mountain foothills at the northern perimeter of the site. Forest clearing in the Strathewen valley has contracted the breeding habitat of these species to the ranges. During late autumn and winter, occasional lyrebirds move downstream along the upper Chadds Creek Road section of Arthurs Creek while whipbirds reach as far downstream as Hewitts Road, above Apted's orchard. Both are subject to predation from cats and foxes. Australian King-Parrots disperse further afield from their breeding grounds into the foothills and lowlands during autumn. While reduced in numbers, they are still seen at this time in flocks of up to 10 birds near the orchards between Arthurs Creek and Strathewen. A pair was seen inspecting hollows near the Chadds Creek confluence in late August 1990. The Red-browed Treecreeper also breeds in this section of the creek. They are reasonably common upstream and rare downstream.

85^{abc}: Mountain forest birds and bushland links on the slopes of Mt Sugarloaf. The mountain slopes between McKimmies orchard and Eagles Nest Road and between Arthurs Creek and Beale Avenue support the most extensive areas of mountain forest in the site. These connect the Running Creek Headwaters site and Arthurs Creek–Chadds Creek Headwaters site of the Kinglake NP. The bushland has an important role in the winter movements of mountain forest ground birds such as the Superb Lyrebird, Eastern Whipbird, Bassian Thrush and Spotted Quail-thrush into the mid-section of Arthurs Creek.

The Barking Owl and White-throated Nightjar are likely to inhabit the Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) while the Powerful Owl likely inhabits the Messmate herb-rich foothill forest (6.3) and gully woodland (10.2). Time and access constraints prevented adequate faunal survey of these sections. A 20-minute bird count in the front of one of the bushblocks along Eagles Nest Road in August 1990 recorded 41 native bird species including the Brush Bronzewing, Superb Lyrebird, Bassian Thrush and Crescent Honeyeater.

Mammals

85^b: Platypus in the upper Arthurs Creek. One was seen about 1 km upstream of the end of Chadds Creek Road in the winter of 1991 (Turid Johanson pers. comm.). This may be the last surviving population in the Arthurs Creek system. Platypus were present in Arthurs Creek at the junction of Running Creek in 1986 and nearby, upstream of the Eagles Nest Road bridge, but have not been seen in this section since. They were frequently seen at Nutfield 30 years ago (Peter Brock pers. comm.). They are present upstream at Running Creek Reservoir.

Freshwater fish

85^b: Electrofishing Survey: Arthurs Creek–O’Deas Road/Beale Avenue Strathewen

Map reference. 7922 468447. **Altitude.** 185 m. **Survey date.** 14 April 1992 and 5 July 1992 (water quality and flow readings)

Vegetation. Instream: emergent herbfield. Bank: Manna Gum riparian forest: (5.3; fair condition with woody and grassy weeds). Frontage: Messmate herb-rich foothill forest: (6.3; remnant and weed invaded)

Physical Features:**Pools**

Substrate. Deep silt, leaves, branches and logs on sheet siltstone; channel scoured; log jams at downstream end of pools

Maximum size (mid-autumn). 2.0 m wide by 0.5 m deep by 10 m long

Riffles

Substrate. Sand, gravel and rocks on sheet siltstone

Flow (mid-autumn minimum): Size. Nil. **Velocity.** Nil. **Rate.** Nil

Flow (mid-winter normal): Size. 2.5 m wide by 20 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 48 ML/day

Water quality

Autumn: Temperature. 17.0°C. **Conductivity.** 100 ms. **Salinity.** 0 ppt. **Turbidity.** High

Winter: Temperature. 10.2°C. **Conductivity.** 70 ms. **pH.** 6.65. **Dissolved Oxygen.** 11.2 ppm. **Turbidity.** Clear

Fish Recorded During Survey

Native species numbers/status. Mountain Galaxias (6); likely breeding resident

Alien species numbers/status. Nil

Other comments. Land tenure: council reserve and cleared farmlets.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Intact links to the Arthurs Creek–Chadds Creek Headwaters site (H/S), Running Creek Headwaters site (H/S) and Chadds Creek site (H/S). Fragmented links to the Arthurs Creek to Strathewen site (M/R). The primary importance of the site is as a dry foothills habitat link between the two sites in the Kinglake National Park West unit.</p> <p>Extensive and intact stands of herb-rich foothill forest north of Eagles Nest Road (Eagles Nest block) backing onto Mt Sugarloaf connect the Running Creek Headwaters site of Kinglake NP. To the east of the upper section of Arthurs Creek, herb-rich foothill forest connects upslope to damp sclerophyll forest in Kinglake NP in the Rifle Range Track block of the Arthurs Creek–Chadds Creek Headwaters site. The damp forest of the sheltered slopes west of the upper section of Arthurs Creek connect the McKimmies Track/Pine Ridge block of the Arthurs Creek–Chadds Creek Headwaters site.</p> <p>Arthurs Creek acts as a partially fragmented, but important habitat link between the Kinglake Ranges and Plenty Upland Hills and Nillumbik Lowland Hills. Blocks of cleared land in the site reduce the effectiveness of these links. Connectivity to downstream sites is severed by land clearing along the Arthurs Creek valley.</p>	
<p>Housing/opening-up of outlying bushland—habitat link severance—Superb Lyrebird decline. The increasing numbers of houses and subdivisions are threatening already restricted faunal habitat links through land clearing, habitat degradation and disturbance. The Eagles Nest block recently underwent a 40 ha subdivision. Some of the blocks are now being grazed by livestock. The long-term loss of habitat links through clearing and grazing and the short-term bushblock/farmlet expansion and associated increase in cat and fox populations has threatened the Superb Lyrebird and other ground and shrub-dwelling species. These will disappear as the gullies are opened up. The native gully vegetation will be replaced by Blackberry. These blocks are diverse in wildflowers including orchids.</p>	<p>Strengthen habitat links. This site and the downstream Arthurs Creek to Strathewen site form the weak links in the significant (both fauna and faunal habitat) Arthurs Creek system. Arthurs Creek should be one of the high priorities for land protection, creek revegetation and weed removal projects in NEM. The middle and upper section sites are the ones requiring the most work, but possibly would be the ones that return the highest success. Arthurs Creek is still one of the most important waterways in NEM and could be restored, particularly for fish, with the implementation of both the habitat link and hydrological strategies.</p> <p>Promotion/implementation of the conservation purposes of the Conservation Zone. Areas such as the Eagles Nest Road bushblocks adjoining the national park require improved management regarding habitat protection and enhancement of bushland. The Shire of Nillumbik needs to promote these activities.</p>

 Regional Hydrological Strategy

Poor water and habitat quality of Arthurs Creek. There are numerous contributing factors. The creek is perennial where it leaves the national park but by Beale Avenue the flow ceases during summer–autumn. This is partly caused by dams and irrigation. Severe channel and bank erosion including slumping and undercutting has occurred. These effects combined with runoff from roads create high levels of stream-bed siltation and summer water turbidity. Pools are lined with about 10 cm of silt and the riffles have silted over.

Native fish eggs (particularly the Freshwater Blackfish) are killed by heavy siltation. The lack of flow causes pools to build up a surface film of oil from rotting eucalyptus leaves. The tannin in combination with suspended mud make the water dark. Reduced sunlight penetration causes the oxygen level of the water to drop to critically low levels in summer-autumn. This restricts the breeding success of Mountain Galaxias as their eggs require well-oxygenated, clear water riffles.

The erosion and siltation has resulted from timber harvesting of the forest catchment in the mid twentieth century and settlement and intensive farming in the valley. Clearing of creek frontage land has also had a significant effect. Upland streams support little aquatic vegetation and the instream food chain is supported by offstream food sources. For example, the Mountain Galaxias is reliant on terrestrial invertebrate prey which fall from riparian vegetation or alight on the water surface. Clearing of frontage vegetation has lowered the productivity of the stream. Several houses in the Chadds Creek Road area are situated very close to the banks of Arthurs Creeks. Earthworks, weeds and domestic pollution from these have led to further stream degradation.

Restoration of water flow and improvement in water quality. If the water flow of Arthurs Creek were restored to a more natural regime and the water quality was improved, there is potential for native fish such as the Freshwater Blackfish, Common Galaxias and Broad-finned Galaxias to re-establish in the stream. At least one instream dam occurs along Arthurs Creek. This has blocked the movements of migratory galaxias. The whole system of Arthurs Creek down through the Diamond Creek and Yarra River to the sea needs to be targeted for priority works that enhance the habitat and movements of the native migratory fish.

Instream fauna and water quality assessment studies. Along with freshwater fish, the Platypus and Rainbow Bee-eater are indicator species of aquatic ecosystem fitness. Both have declined alarmingly in Arthurs Creek. A fully integrated study on the hydrology, water chemistry, substrate physiography, flora and fauna (vertebrate and invertebrate) should be conducted for the system.

Beale Avenue electrofishing site. The past and present catchment land-use has led to a severe deterioration of flora and fauna values of the creek. Implementation of the strategy would require rationalisation and reformation of water use throughout the catchment. The most important item of the strategy to be addressed for this section of the creek would be to attempt to restore natural flow rates by releasing some of the water tied up in dams at critical low flow periods of the year.

Brown Trout have been stocked in the instream dam at the north end of Chadds Creek Road. They run upstream into the swift flowing water to breed. Trout compete with and prey upon the Mountain Galaxias and Broad-finned Galaxias

Many of the old farm dams in the middle and upper catchments were part of large properties and are no longer fully utilised on the small farms. Serving small numbers of livestock and fire protection, they remain fairly full over summer. Water released from a network of dams at low flow periods would flush out the stagnating pools. There must be a restriction on further proliferation of dams (especially large dams) on hobby farms.

Dam blocking the migratory movements of Broad-finned Galaxias.

Broad-finned Galaxias were recorded just downstream of the electrofishing site in the mid-1980s (Bill O'Connor pers. comm.; Raadik in prep.). An instream dam is present on Arthurs Creek about 1 km downstream of the electrofishing site. The dam outflow is a 10 cm pipe about 50 cm above the ground. This produces a high velocity burst of water when the stream runs high. Migratory species such as the Common Galaxias (not recorded but likely present in the stream) would not be able to negotiate this barrier. Broad-finned Galaxias may be able to pass over the wall but this would be a difficult and hazardous procedure (e.g. exposure to predation and desiccation). If they reach the dam they have to pass by the large trout and then run up the 2 km or so of the stream which contains the trout fingerlings. If still present by this stage, they possibly move above the waterfalls to breed.

Fish-way at the instream dam. Migratory fish would be prohibited from negotiating the outlet (gushing water pipe) of the instream dam in Arthurs Creek, north of the end of Chadds Creek Road. The installation of a fish-way would be desirable but the works would likely be prohibitively expensive without assistance with funding. It may prove cheaper and more environmentally sound to remove the dam as the Brown Trout may die out. This would facilitate population recoveries of Mountain Galaxias and Broad-finned Galaxias and improve the summer flow rate of downstream sections of the creek.

Recent recommendations. A recent consultant study for Melbourne Water recommended that the dam be dismantled, an initiative fully endorsed by this study.

With funding from Melbourne Water, rehabilitation works are planned for summer 1996/97. The 3 m drop is to be tapered and formwork set in place to prevent further erosion. The Strathewen LandCare Group is planning to revegetate the creek banks with local plants.

Since 1993, a serious situation has arisen with regard to soil erosion. The creek has formed a new course in an attempt to by-pass the dam. In departing from the old rocky creek channel, the creek has cut a 3 m deep erosion channel for several hundred metres through a cleared section of floodplain alluvium.

In autumn 1996 an on-site meeting was held involving land-owners, representatives from Melbourne Water, NRE and the Shire of Nillumbik. Works to halt the erosion were discussed.

This author raised the conservation issues including the migratory fish, effect of trout, the need to isolate the dam from the creek and revegetation.

There needs to be a Region-wide study on the impact of instream dams in perennial waterways, particularly regarding the stocking of alien fish and the disruption of stream flow and migratory movements of native fish. A land-owner awareness exercise as to the presence and ecological requirements of native fish is required. No further permits for instream dams in NEM should be approved without full Environmental Impact Assessments. One of the requirements for perennial streams such as Arthurs Creek would be that a side spillway with a properly designed fish-way should be installed in any proposed instream dam.

Feral cat and fox control. Unless the level of cats and foxes penetrating the mountain bushland areas from cleared valleys in the site can be controlled, ground-dwelling birds such the Superb Lyrebird, Eastern Whipbird, White-throated Nightjar, Spotted Quail-thrush and Bassian Thrush will continue to decline.

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat.

Site 86 Chadds Creek

- Map Reference:** 7922 468426 to 7922 503444 (Chadds Creek). One minute lat/long grids include 37° 32' x 145° 17' to 145° 18' and 37° 33' x 145° 16' to 145° 17'.
- Location/Size:** Chadds Creek from the confluence with Arthurs Creek to Kinglake NP. Approximately 740 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: nil apart from the road sides. Private: zoned for conservation (large bushblocks abutting the national park in the northern section of the unit) Farmland, orchards/market garden and livestock.
- Landforms:** Mountain and foothill (see NUH C). Elevation is 170–420 m.

HABITAT SIGNIFICANCE

Assessment: High–Category 2

Relatively intact and extensive stands: Mountain Grey Gum damp riparian forest (3.1; upper Chadds Creek); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Manna Gum gully woodland (10.1); Messmate–Mountain Swamp Gum gully woodland (10.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark valley forest (31.1); each of the above are amongst the most intact stands on private land in NEM

Partially intact or small stands: Messmate damp sclerophyll forest (4.2); Mealy Stringybark heathy woodland (9.1); Messmate–Green Scentbark heathy woodland (9.2)

Critical assemblages or populations: Strategic Habitat Link. Diverse overlap of mountain and foothill orchids; high representation of intact and extensive vegetation types

Notable features: stands of Green Scentbark (*Eucalyptus fulgens*) on Rankines Road in Chadds Creek valley

FAUNAL SIGNIFICANCE: Site 86 Chadds Creek

Assessment: State–Category 3 (B, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

86^a: 37° 32' x 145° 16'; lower Bowden Spur Road

86^b: 37° 32' x 145° 17'; middle Chadds Creek at Rankines Road

86^c: 37° 33' x 145° 16'; lower Chadds Creek

86^d: 37° 33' x 145° 17'; south end of Rankines Road/lower Bald Spur Road

86^e: 37° 33' x 145° 18'; middle Bald Spear Road

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 86^b: Masked Owl, Barking Owl, Powerful Owl, Common Dunnart, Tree Goanna, Mountain Galaxias

State. 86^e: Barking Owl, Brush-tailed Phascogale, Common Dunnart, Tree Goanna

Regional. 86^a: Barking Owl, Powerful Owl, Tree Goanna

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 86^b: 9 species including the White-throated Gerygone in the valley of the Chadds Creek middle branch at Rankines Road on 12 November 1990

h. Bats

Regional. 86^b: 5 species including the Gould's Long-eared Bat trapped on the Chadds Creek middle branch at Rankines Road on 13/14 November 1990

i. Arboreal mammals

Regional. 86^b: 4 species including the Koala and Sugar Glider in the valley of the Chadds Creek middle branch at Rankines Road on 12 November 1990

j. Ground mammals

Regional. 86^b: 7 species including the Common Dunnart, Brown Antechinus and Bush Rat in the valley of the Chadds Creek middle branch at Rankines Road on 12 November 1990

k. Frogs

Regional. 86^b: 6 species on the Chadds Creek middle branch at Rankines Road on 27 August 1990

l. Reptiles

Regional. 86^b: 8 species in the valley of the Chadds Creek middle branch at Rankines Road on 12 November 1990

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 86^b: 122 species

b. Native birds

Regional. 86^b: 86 species

c. Native mammals

Regional. 86^b: 18 species

d. Herpetofauna

Regional. 86^b: 18 species

e. Freshwater fish

Local. 86^b: 1 species (Mountain Galaxias)

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 86^b: 20 species

b. Regionally endangered fauna (R1 species)

Regional. 86^b: 2 species. **Birds:** Masked Owl. **Reptiles:** Eastern Bearded Dragon

c. Regionally vulnerable fauna (R2 species)

State. 86^b: 7 species. **Birds:** Barking Owl, White-throated Nightjar, Hooded Robin, White-throated Gerygone, Chestnut-rumped Heathwren. **Mammals:** Common Dunnart. **Reptiles:** Tree Goanna

Regional. 86^a: 4 species. **Birds:** Barking Owl, White-throated Gerygone, Satin Bowerbird. **Reptiles:** Tree Goanna

Regional. 86^e: 4 species. **Birds:** Barking Owl. **Mammals:** Brush-tailed Phascogale, Common Dunnart. **Reptiles:** Tree Goanna

d. Regionally rare fauna (R3 species)

Regional. 86^b: 3 species. **Birds:** Spotted Quail-thrush. **Mammals:** Feathertail Glider, Gould's Long-eared Bat

Regional. 86^a: 1 species. **Mammals:** Feathertail Glider

e. Regionally depleted fauna (R4 species)

Regional. 86^b: 8 species. **Birds:** Powerful Owl, Australian King-Parrot, Superb Lyrebird, Leaden Flycatcher, Eastern Whipbird, Bassian Thrush, White-winged Triller. **Fish:** Mountain Galaxias

Regional. 86^a: 4 species. **Birds:** Powerful Owl, Leaden Flycatcher, Bassian Thrush, Rufous Songlark.

f. Regionally restricted fauna (R5 species)

Regional. 86^b: 12 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Reptiles:** Delicate Skink, McCoy's Skink. **Mammals:** Koala. **Frogs:** Southern Toadlet, Striped Marsh Frog

Local. 86^a: 1 species.

F. POPULATION DENSITY: Viability and Abundance–point census

i. Bat trapping rate

Regional. 86^b: trap-night average of 10 in the valley of the Chadds Creek middle branch at Rankines Road over 12 and 13 November 1990

m. Regionally depleted fauna

Regional. 86^b: about 30 Mountain Galaxias seen along a 300 m section of the Chadds Creek west branch between Rankines Road and a logging track crossing (Fraser Road) on 9 November 1992

Outlook

The faunal significance may decline from State to Regional with further fragmentation or encroachment within the habitat link by bushblock housing, land clearing or degradation of bushland understorey by livestock grazing. The Tree Goanna and Superb Lyrebird will be most likely affected.

FAUNA

Rare or Threatened Fauna

Bc **86^{abe}: Powerful Owl and Barking Owl.** The Chadds Creek is an important area for owls, the primary reasons being the large Manna Gums and Yellow Box along the creek and abundance of arboreal prey and rabbits. Two interviewed people had heard Powerful and Barking owls (Drew Gregory and Hank Vruelink). Powerful Owls breed in a Mountain Grey Gum in the nearby Arthurs Creek–Chadds Creek Headwaters site. One was seen in the upper section of the Chadds Creek west branch near a logging track bridge (Fraser Road) on 9 November 1992. The lower Chadds Creek provides hunting grounds for this pair. A Barking Owl was heard calling at Rankines Road on the Chadds Creek middle branch on 12 November 1990.

Bc **86^b: Masked Owl.** One responded on dusk to a playback call at Rankines Road on the Chadds Creek middle branch on 12 November 1990. The bird was sitting at the entrance to a hollow in a large Yellow Box. There was no evidence of young in the hollow. After initial vocal response the bird dispersed on repeated playing of the call. Two nesting pair of Southern Boobooks were seen along the creek during the evening.

Bc **86^{be}: Brush-tailed Phascogale and Common Dunnart.** The phascogale occurs in Red Stringybark herb-rich foothill forest (6.1), Messmate herb-rich foothill forest (6.3) and Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) while the dunnart occurs in 6.1 and 11.4 in the headwaters of the Chadds Creek middle branch west of Bald Spur Road (Piers Bateman pers. comm.). A Common Dunnart was also located on 12 November 1990 under a pile of split Red Stringybark palings on the hill-crest south of Rankines Road, about the Chadds Creek middle branch.

- Bc* **86^{abe}: Tree Goanna.** Four people interviewed had made a recent observation. A sighting was also made by this author on 28 August 1990. A breeding observation was made at Bald Spur in the adjacent Arthurs Creek–Chadds Creek Headwaters site. This and the Mount Everard to Steels Creek sections of the national park are the stronghold of the species in NEM. There are no recent records from west of Mt Sugarloaf. The Chadds Creek is an important habitat link from the ranges to the foothills for the Tree Goanna.
- Bc* **86^b: Mountain Galaxias.** About 30 were seen in pools over a 300 m section of Chadds Creek west branch near the logging track bridge (Fraser Road extension) on 9 November 1992. A similar effort on 7 June 1992 after a dry period of several months, when the creek flow was negligible, failed to record any. The deepest pools, about 0.3 m, maintain small populations of Mountain Galaxias (see Arthurs Creek–Chadds Creek Headwaters site). The Mountain Galaxias may move into underground sections of the stream. The galaxias would not have moved upstream from Arthurs Creek as they would not be able to negotiate the 30 cm climb up to the outlet pipe under Rankines Road (see conservation measures).

OTHER SIGNIFICANT FAUNA

Birds

- Ec* **86^b: Chestnut-rumped Heathwren, Hooded Robin and White-throated Nightjar.** The heathwren and robin were seen in Burgan/Prickly Tea-tree shrubland, under Messmate–Mealy Stringybark heathy woodland (9.2) in the valley of Chadds Creek middle branch downstream of Rankines Road on 12 November 1990. Both species utilise regrowth stands of wattles or tea-tree and were presumably breeding but the undergrowth was too dense to find the nests. Few breeding records were made for either in NEM. White-throated Nightjars were heard calling from the nearby exposed hill-slopes while spotlighting.
- Ed* **86^b: Breeding Spotted Quail-thrush.** The nest was located under Red Stringybark herb-rich foothill forest (6.1) on the lower hill-slopes of the Chadds Creek middle branch, downstream of Rankines Road in November 1990. It was placed near the ground amongst Silvertop Wallaby-grass and Thatch Saw-sedge tussocks. The incubating bird flushed to a thicket of Burgan and Prickly Tea-tree nearer the creek. A quail-thrush had been present in the same locality in late August 1990. Few other quail-thrush breeding observations were made in the foothills. Formerly widespread, they are now mostly non-breeding visitors from the ranges.
- Ee* **86^b: Breeding Superb Lyrebird and Eastern Whipbird.** The lyrebird breeds in Mountain Grey Gum damp riparian forest (3.1) along Chadds Creek. A population of four or five exists in the dense scrub along the upper section of the west branch near a logging track bridge (Fraser Road). An incubating female and an active mound were observed on 9 November 1992. Birds move down the creek and cross Rankines Road during autumn–winter. A pair of breeding Eastern Whipbirds was seen in Manna Gum gully woodland (10.1) in the downstream section of the middle branch on 12 November 1990. Few whipbirds and fewer breeding observations were recorded in the foothills during the study. This species was common in the upland hills in the early 1970s. Common Blackbirds and settlement have advanced into the outlying bushland over this period.
- Ee* **86^b: Breeding Bassian Thrush and Australian King-Parrot.** The thrush nest was located in a Prickly Moses (3.1) along the Chadds Creek west branch near the old logging track bridge north of Fraser Road in November 1992. The breeding presence of the species is a key indicator of the importance of the site with regard to extent and intactness of ground habitat and connectivity to extensive areas of damp forest in the national park. A flock consisting of an adult pair and three juvenile Australian King-Parrots was seen in Messmate herb-rich foothill forest (6.3) west of Bald Spur Road in the upper reaches of the Chadds Creek middle branch in December 1990. The young were just flying and the parents must have bred locally. A single king-parrot was also observed in Manna Gum gully woodland (10.1) at Rankines Road on 26 August 1990.

86^b: Breeding valley forest/gully woodland migratory birds. Manna Gum gully woodland (10.1) along the Chadds Creek and flanking Yellow Box–Candlebark valley forest (31.1) is the preferred habitat of the White-throated Gerygone in NEM. Several were heard near the junction of the west and middle branches of the Chadds Creek. The Brush Cuckoo, Leaden Flycatcher, Satin Flycatcher (several pair), Rufous Fantail (several pair), Sacred Kingfisher and White-winged Triller were also present in the valley forest and gully woodlands. All were recorded breeding during a bird survey conducted on 12 November 1990.

Mammals

Ed **86^{ab}: Feathertail Glider.** One feathertail along with several Sugar Gliders were seen in Silver Wattles while spotlighting the Chadds Creek middle branch on 12 November 1990. The Feathertail Glider was also recorded downstream of the west/middle branch junction (Hank Vruelink pers. comm.).

Ed **86^{ab}: Gould's Long-eared Bat.** This is predominantly an upland species in NEM. One was trapped along with four other species of bats on 12 November 1990 under Manna Gums (5.3) near the Chadds Creek middle branch, just downstream of Rankines Road.

Reptiles

Eb **86^b: Eastern Bearded Dragon.** One was recorded in Long-leaf Box–Red stringybark box–stringybark woodland (11.4) south of Rankines Road on 12 November 1990. This was one of only three remaining natural populations in NEM. The second occurs in the Edgars Creek headwaters of the Merri Lowland Volcanic Plains. The third occurs at Pittle's Paddock near Cottles Bridge (site 69). From local interviews it appears that the dragon was once widespread in the box-stringybark woodlands of the Nillumbik Upland Hills between Strathewen and Smiths Gully.

The range of the Eastern Bearded Dragon severely contracted after World War 11, similar to the decline of other ground fauna species including the Grey-crowned Babbler. This was a time of extensive land clearing and logging in the hills. An acute loss of cover and food in the rabbit plagues and post-Myxomatosis predation from foxes (scavenging for other prey in the absence of rabbits) would have also had substantial effects. Foxes take the eggs of large reptiles such as the bearded dragon as they are laid in shallow excavations in the soil. In recent decades the dragon has suffered from 1080 baiting and road-kill.

86^b: McCoy's Skink. This is predominantly an upland species in NEM. Several were located in Yellow Box–Candlebark valley forest (31.1) on 12 November 1990 under logs above the floodplain of the Chadds Creek middle branch downstream of Rankines Road.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Strategic Habitat Link. Intact links to the Arthurs Creek–Chadds Creek Headwaters site, Diamond Creek Headwaters site, Arthurs Creek Upper Reaches site and the Arthurs Creek to Strathewen site. Fragmented links to the Diamond Creek Upper Reaches site and Hewitts Road site. The Chadds Creek site is the most important link between Kinglake NP and Arthurs Creek. Movements between the ranges and upland hills of Tree Goannas and damp forest species such as the Superb Lyrebird are critically dependent on the link.

Bushblock housing and attrition of conservation values. Much of the bushland adjoining Kinglake NP is zoned Conservation. There is a lack of appropriate presence and enforcement of its purposes by Nillumbik council and poor conservation awareness amongst landowners. There is no plan to address the disturbance and habitat loss and degradation surrounding the increasing level of dwellings and subdivisions and associated intensity of land-use. The present levels are threatening already restricted faunal habitat links through land clearing, degradation and disturbance. Conflicts created by land settlement are leading to widespread attrition of conservation values. There is an acute lack of land protection works (e.g. weed control).

Strengthen Strategic Habitat Link. Enhancement and protection of the Chadds Creek link is fundamental in the maintenance of faunal populations in the middle Arthurs Creek

Regional Hydrological Strategy

Farming along the lower Chadds Creek streamway. Similar to the effects of bushblock housing, intensive agricultural use such as livestock grazing and orchard and market gardening in or surrounding the streamways and gullies increases the potential for conflict with flora and faunal values. There are already too many dams in the system to maintain natural flow rates. Large servicing dams are still being constructed in natural gullies. Reduced water flow of Arthurs Creek has already become a serious conservation issue (see Regional Hydrological Strategy).

Integrated streamway conservation management required over the whole Arthurs Creek catchment. The water quality of the lower Diamond Creek system is poor. A catchment conservation management plan to rectify its causes must be addressed. The future conservation of Arthurs Creek requires greater levels of protection along the most natural tributaries such as the Chadds Creek.

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat and earthworks such as dam constructions.

The lower 500 m of Chadds Creek crosses farmland and cattle graze to the creek banks. The poor condition of banks and lack of riparian vegetation of this section is a source of pollution in Arthurs Creek and has created a major bottleneck for faunal movement, particularly fish. Blackberry is the main ground cover plant. There are indications of salinity and pollution in the lower section of Arthurs Creek and a significant pollution problem downstream in the Diamond Creek.

Pipe under the Chadds Creek west branch at Rankines Road. The 30 cm drop from the outlet to the pool below prevents the movement of Mountain Galaxias and restricts the movement of species such as the Broad-finned Galaxias up the creek. If a severe drought were to occur and the upstream pools were to dry out the galaxias might be eliminated from the upper reaches of the creek. The Mountain Galaxias must be considered as being threatened in the Arthurs Creek system. Populations are declining due to instream barriers, inadequate summer flow regime, poor water quality and the presence of Brown Trout (see Regional Hydrological Strategy in volume 1).

Streamway protection and revegetation works along Chadds Creek. Much of the Chadds Creek upper catchment is protected from livestock grazing. The lowest section upstream of the Cottles Bridge–Strathewen Road is grazed. The landowner should be advised of the vital function of the creek as a habitat link and the impact of the cattle on the important fish in the creek. Assistance should be provided to fence the streamway to regenerate a strip of riparian vegetation. This would improve the water quality and utility of the habitat link. In conjunction with consolidation works upstream this should be a high priority given the importance of Chadds Creek as a habitat link. The bulk of the remaining riparian habitat of the Strathewen unit and the downstream Hurstbridge to Strathewen unit is degraded and fragmented. Blackberry, rabbit and fox control should be exercised along the Chadds Creek.

Pipe under the Chadds Creek west branch at Rankines Road. Rocks should be built up under the outlet to enable Mountain Galaxias to move from Arthurs Creek to the upper reaches of the Chadds Creek. This simple operation might be vital for the long-term survival of the galaxias in the Arthurs Creek system.

Other Issues

Logging and soil erosion in regrowth forests. The exposed slopes above the eastern side of Chadds Creek west branch, north of Rankines Road contain regrowth Mealy Stringybark heathy woodland and Messmate herb-rich foothill forest (lower slopes and broad sections of the valley). Rabbits invaded the area some time after the logging/land clearing and caused considerable erosion in the gullies and on the slopes.

Site 87 Hewitts Road

- Map Reference:** 7922 459397 (mid-point of the Apted/Nink's bushland). One minute lat/long grids include 37° 34' x 145° 15'.
- Location/Size:** The larger bushblocks surrounded by the Cottles Bridge–Strathewen Road, Shaws Road, Hildebrand Road and Hewitts Road owned by the Apteds, Ninks and Arthur Hewitt and adjoining smaller blocks on the north side of Hewitts Road. Approximately 170 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: nil apart from Hewitts Road frontage. Private: farmland, livestock; some ungrazed bushblocks. Nearby orchards zoned General Farming.
- Landforms:** Foothill (see NUH C). Elevation is 150–250 m.

HABITAT SIGNIFICANCE

Assessment: High–Category 2

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Messmate–Mountain Swamp Gum gully woodland (10.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Messmate herb-rich foothill forest (6.3)

Vulnerable species: Wine-lip Spider-orchid

Rare species: Yarra Gum

Critical assemblages or populations: gully flora along tributaries of Apted's dam; diverse orchid flora including the regionally endangered Sickie Greenhood and regionally vulnerable Bronze Caladenia

FAUNAL SIGNIFICANCE: Site 87 Hewitts Road

Assessment: Regional–Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

87^a: 37° 34' x 145° 15'; Apted's bushland/Hewitts Road, Strathewen

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 87^a: Barking Owl, Brush-tailed Phascogale, Tree Goanna

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 87^a: 9 species including the Sacred Kingfisher and Leaden Flycatcher in the valleys upstream of Apted's dam from visits on 6 and 21 October 1992

j. Ground mammals

Regional. 87^a: 5 species including the Water Rat (Apted's dam) on 6 October 1992

k. Frogs

Regional. 87^a: 7 species including the Bibron's Toadlet and Growling Grass Frog at the upstream end of Apted's dam from visits on 6 October and 21 October 1992

l. Reptiles

Regional. 87^a: 8 species including the Common Long-necked Tortoise, Delicate Skink, Bougainville's Skink, Weasel Skink and Eastern Three-lined Skink from a 60-minute search of Apted's bushland on 21 October 1992

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 87^a: 130 species

b. Native birds

Regional. 87^a: 101 species

c. Native mammals

Regional. 87^a: 13 species

d. Herpetofauna

Regional. 87^a: 16 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 87^a: 10 species

c. Regionally vulnerable fauna (R2 species)

Regional. 87^a: 4 species. **Birds:** Barking Owl, White-throated Gerygone. **Mammals:** Brush-tailed Phascogale. **Reptiles:** Tree Goanna

d. Regionally rare fauna (R3 species)

Regional. 87^a: 2 species. **Birds:** Little Corella, White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 87^a: 4 species. **Birds:** Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Rufous Songlark

f. Regionally restricted fauna (R5 species)

Regional. 87^a: 9 species. **Birds:** Painted Button-quail, Australian Shelduck, Barn Owl, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** Common Long-necked Tortoise, Delicate Skink, Bougainville's Skink. **Frogs:** Bibron's Toadlet

F. POPULATION DENSITY: Viability and Abundance–point census

m. Regionally rare fauna (R2 species)

Regional. 87^a: overnight roost of about 30 Little Corellas and 20 White-browed Woodswallows in the trees at the top end of Apted's dam on 21 October 1992

Outlook

The faunal significance may decline from the important Regional Category 1 to Category 2 due to severance of external habitat links. In combination with pressure from fox and cat predation, the Brush-tailed Phascogale is at risk of elimination. Pastoral weeds have invaded the perimeter bushland from surrounding farmland.

FAUNA

Rare or Threatened Fauna

Bc **87^a: Tree Goanna, Barking Owl and Brush-tailed Phascogale at Hewitts Road.** These species were recorded in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) on the property of Joe and Dini Shepherd to the north of Hewitts Road links south to a stand on Arthur Hewitt’s land. This provides about 20 ha of habitat which is separated by cleared paddocks from Apted’s bushland and Arthurs Creek. The following sightings were provided by Joe Shepherd. The Tree Goanna was seen on one occasion. This had likely moved down from the ranges along the Chadds Creek bushland link. It has not been recorded further south (e.g. Shaws Road site). The Barking Owl was heard on a few occasions. Brush-tailed Phascogales have been observed over 10 years, at one stage occupying the wall of the house.

Other Significant Fauna

Birds

87^a: Migratory insectivorous birds of Apted’s bushland. A bird census consisting of two visits to the valleys upstream of Apted’s dam was conducted in 1992 (6 October and 21 October). Habitats included Red Stringybark herb-rich foothill forest(6.1), Messmate–Swamp Gum gully woodland (10.2) and Yellow Box–Candlebark valley forest (31.1). Nine species including the Sacred Kingfisher and Leaden Flycatcher were recorded. The Sacred Kingfisher nested in a Swamp Gum (10.2) by the upper arm of the dam while the Leaden Flycatcher nested on a branch of a Yellow Box (31.1) on the side of the valley. A flock of 20 White-browed Woodswallows roosted in Swamp Gums and Yarra Gums (10.2) at the top end of the dam and Candlebarks (31.1) flanking the valley on 21 October 1992. It is unknown (though possible) whether the woodswallows stayed to breed. The White-winged Triller, Rufous Songlark and White-throated Gerygone were each recorded breeding in 31.1 in a prior visit on 14 November 1990.

87^a: Waterbirds at Apted’s dam. Fifteen species have been recorded. The Eurasian Coot, Australian Wood Duck, Pacific Black Duck and Grey Teal (dead Swamp Gum in the upper arm) were nesting in October 1992. The Yellow-billed Spoonbill, Black Swan and Australian Shelduck are occasional visitors. The Great Cormorant, Little Black Cormorant and Little Pied Cormorant were each seen in October 1992, suggesting fish, possibly Redfin or Brown Trout, are present in the dam.

Reptiles

87^a: Lizards of Apted’s bushland. Interior sections of the block support excellent ground habitat (logs) for reptiles. Similar habitat is present on the adjoining Nink’s property. Seven lizard species were recorded during a 60-minute search on 21 October 1992. The Delicate, Weasel and Eastern Three-lined skinks were located under logs in Yellow Box–Candlebark valley forest (31.1). The Bougainville’s Skink was located in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) under a flat stone on the ridge. Tree Dragons were moderately common and several Common Blue-tongued Lizards were recorded. A Common Long-necked Tortoise sunning on a log in the shallows of the upstream end of the dam was also seen. No snakes were located.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Fragmented links east to the Cottles Bridge to St Andrews site and west to the Arthurs Creek to Strathewen site.</p>	
<p>Cleared farmland and livestock grazing effects on the bushland. The surrounding farmland contains few native understorey plants. Sheep have created a dense sward of Cape Weed on the hill-crest and exposed hill-slopes of Hewitt's. Grazing on Nink's and Hewitt's has reduced the native ground and shrub layer species under the bushland (e.g. fewer orchids) compared with the ungrazed Apted's bushland.</p> <p>Sweet Vernal-grass and Large Quaking-grass promoted by grazing have invaded perimeter sections of Apted's bushland. The grazed blocks still contain wildflower patches (e.g. over 20 orchid species including Common Bird-orchids along the gullies). The upper gullies have undergone erosion. A few Rough Tree-ferns are still present. The ungrazed bushland block is possibly of insufficient size to buffer the effects of the surrounding cleared land and grazed bushland in the long term. The spread of alien grass into Apted's bushland from the edges may ultimately eliminate many of the orchids.</p> <p>Gully erosion from rabbits and grazing pressure from kangaroos. The upper gullies have severe tunnel erosion caused by rabbits, possibly 20 or 30 years ago. Surrounding bushland appears to have been logged 50 or more years ago causing some sheet erosion on the hills and exposed slopes. A substantial population of Eastern Grey Kangaroos (over 100), inhabits the Apted/Nink's bushland. The total area of bushland is possibly 100 ha. The extent of Apted's bushland ungrazed by livestock is about 20 ha. The kangaroo population is placing heavy grazing pressure on the shrubs (particularly peas and wattles). Their trampling is assisting the spread of introduced grasses.</p>	<p>Reduced livestock grazing intensity in significant sections of bushland adjoining Apted's. Restriction of grazing to between early summer and early autumn would be beneficial for the winter-spring wildflowers. Significant orchid areas and erosion-prone sections should be fenced to exclude livestock grazing and effect regeneration.</p> <p>Protection of ground logs. The steep bushland slopes contain abundant logs and support diverse lizard populations. These areas are significant as many bushblocks in the foothills (e.g. Dunmoochin) have had the ground logs removed for firewood. The latter support few lizards except the Garden Skink. It is important that the ground logs are protected. The logs restrict soil erosion and protect many of the orchids such as the greenhoods and helmet-orchids. They also provide homes for ants and other invertebrates.</p>
Other Issues	

Montpellier and Flax-leaf Broom on Hewitts Road. Infestations are spreading along the road. Patches also occur along Hildebrand/Jacksons Road, Shaws Road and the Cottles Bridge–Arthurs Creek Road. Seed dispersal is occurring into the bushland but the livestock and kangaroos are preventing establishment. A fire in the area may lead to massive infestations of broom.

Montpellier and Flax-leaf Broom control. Locals have commenced pulling the broom along Hewitt's Road. Council sprayed the broom in November 1992 but this needs constant follow-up. The broom needs to be controlled before it spreads. Control of broom and local outbreaks of Boneseed should be targeted by the Strathewen LandCare Group.

Strathewen LandCare Group. Apted's bushland is one of the most significant blocks in the group area. Management assistance in the form of technical information and resources should be provided.

PLENTY UPLAND HILLS (PUH)

Bushland catchments of Yan Yean Reservoir and bushland and farmland catchments of the upper reaches of tributaries of the Plenty River including the Bruces Creek and the western tributaries of Arthurs Creek.

Past land-use: pastoral, water supply, townships, orchards and firewood. Present land-use: pastoral, water supply, bushblock and farmlet settlement, townships, orchards and recreation (e.g. Yan Yean Reservoir picnic area).

Native vegetation cover: highly fragmented apart from the sections adjoining the ranges including the Yan Yean Reservoir catchment, which are extensive.

Key biological features (mostly at Yan Yean Reservoir):

Fauna: Peaceful Dove, Blue-billed Duck, Swift Parrot, Rainbow Bee-eater, Brown Treecreeper, Regent Honeyeater, Large-footed Myotis; faunal rarity, abundance and diversity (particularly waterfowl); strategic habitat link between the ranges and lowland hills/plains

Flora: Clover Glycine; Large-fruit Groundsel; herb-rich foothill forests (Red Stringybark and Messmate); heathy forest; grassy woodland ecological reference area (Yellow Box–Candlebark and Snow Gum); box–stringybark woodland (Yellow Box–Red Stringybark and Long-leaf Box–Red Stringybark); habitat rarity and abundance; orchid rarity and diversity.

Key areas/physical features for biota: Yan Yean Reservoir catchment.

7 sites of significance: 2 state and 5 regional for fauna and 2 very high and 5 medium for habitat.

PUH A DOREEN–NUTFIELD–DEEP CREEK–RUNNING CREEK

This management unit consists of three sites of regional faunal significance (sites 88, 89 and 90).

Map Reference: 7922 367335 to 7922 405445 (south to north point); 7922 355373 to 7922 446431 (west to east point).

Location/Size: The unit contains the catchments on the west side of Arthurs Creek stretching from Doreen to the southern margin of the Kinglake Ranges. Approximately 2300 ha.

Municipality: Shire of Nillumbik.

Physical Features

The management unit lies in the Eastern Uplands and contains the transition from the higher and younger (Devonian) Kinglake Plateau of the ranges in the north to the older (Silurian) foothills in the south. The Devonian rock formations in the ranges overlie the Silurian formations. A ridgeline (Yan Yean Road/Ridge Road) marking the boundary between the Plenty River and Arthurs Creek catchments occurs along the western perimeter. The northern foothills of the unit descend from the Kinglake Ranges. The unit predominantly contains heavily cleared undulating hills, separated by gullies and creek valleys.

Landforms

Mountain: slopes, ridges and gullies. Foothills: ridges, hill-crests, hill-slopes valleys, gullies, creeks and floodplains and farm dams. Elevation is 100–400 m (Lobb Hill).

Hydrology

The Deep, Running and Stewart Ponds creeks are ephemeral fourth order streams. Doctors Gully Creek is small and contains a local catchment. Running Creek was perennial but now flows for about nine months a year due to heavy land clearing in the middle reaches and retention of water in Running Creek Reservoir. During winter-spring Running Creek is a swift-flowing stream, carrying about the same amount of water as Arthurs Creek. The mid-section of Running Creek flows down a deeply incised valley. The streams contain cobble and gravel riffles, sand bars and sections of rocky cascades. Undercut banks surround open water pools (< 1 m deep) with submerged logs and emergent snags. The creek channels are deeply scoured and the banks have undergone severe erosion, caused by extensive land clearing and livestock grazing of the frontages and catchments. The Deep and Stewart Ponds creeks are reduced to strings of muddy pools during summer–autumn.

Rainfall: 700–800 mm.

Site 88 Deep Creek–Running Creek

- Map Reference:** 7922 404396 to 7922 396433 (Deep Creek from south of Brennans Road East upstream to where it leaves Deep Creek Road); 7922 421401 to 7922 430440 (Running Creek from Brennans Road East to Kinglake National Park. One minute lat/long grids include 37° 32' x 145° 11' to 145° 12', 37° 33' x 145° 10' to 145° 12' and 37° 34' x 145° 11').
- Location/Size:** Foothill catchments of the Deep and Running Creeks between Brennans Road East and Kinglake National Park. Approximately 1100 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Water Frontage (small strip on the east side of Running Creek, north of the transmission line); Vic Road reservations (e.g. Arthurs Creek Road, Deep Creek Road, Running Creek Road and Brennans Road). Private: General Farming and farmland; livestock grazing, some orchards and uncleared land abutting Kinglake National Park in the upper tributaries of Running Creek.
- Landforms:** Mountain and foothill (see PUH A). Elevation is 120–413 m (Lobb Hill).

HABITAT SIGNIFICANCE

Assessment: Medium–Category 1

Partially intact or small stands: Messmate damp sclerophyll forest (4.2); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Messmate gully woodland (10.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark valley forest (31.1); 4.2–11.4 occur in the upper tributaries of the Deep and Running Creeks

Rare species: Yarra Gum

Notable features: Yellow Box–Candlebark valley forest along the lower Deep and Running Creek Roads. The shrub and field layers are depleted and weedy but the trees contain ample nesting hollows

FAUNAL SIGNIFICANCE: Site 88 Deep Creek–Running Creek

Assessment: Regional–Category 1 (B, C, D, E)

Reference grids for the significance keys include:

88^a: 37° 32' x 145° 11'; upper Deep Creek/Deep Creek Road to Lobb Hill

88^b: 37° 32' x 145° 12'; upper Running Creek/Running Creek Road, Streamville

88^c: 37° 33' x 145° 11'; lower Deep Creek

88^d: 37° 33' x 145° 12'; lower Running Creek

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 88^d: Mountain Galaxias, Freshwater Blackfish (Running Creek)

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

g. Breeding parrots

Regional. 88^a: 5 species including the Long-billed Corella in a 2-hour search along Deep Creek/Deep Creek Road on 6 November 1992

k. Frogs

Regional. 88^a: 6 species including the Growling Grass Frog in a 2-hour search along Deep Creek/Deep Creek Road on 6 November 1992

I. Reptiles

Regional. 88^b: 8 species including the Tree Dragon, Delicate Skink, Weasel Skink, McCoy's Skink, Eastern Three-lined Skink and Lowland Copperhead at upper Running Creek Road, Streamville on 19 December 1992

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 88^a: 79 species. **88^b:** 73 species

b. Native birds

Regional. 88^a: 63 species. **88^b:** 57 species

c. Mammals

Local. 88^b: 5 species. **88^a:** 4 species

d. Herpetofauna

Regional. 88^a: 12 species. **88^b:** 11 species

e. Freshwater fish

Regional. 88^d: 4 species in Running Creek upstream of Brennans Road East: Short-finned Eel, Mountain Galaxias, Freshwater Blackfish and Southern Pigmy Perch

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 88^d: 3 species

c. Regionally vulnerable fauna (R2 species)

Regional. 88^a: 1 species. **Birds:** Satin Bowerbird

Regional. 88^d: 1 species **Fish:** Freshwater Blackfish

e. Regionally depleted fauna (R4 species)

Regional. 88^a: 4 species. **Birds:** Australian King-Parrot, Rainbow Bee-eater, White-winged Triller, Rufous Songlark

Regional. 88^d: 2 species. **Fish:** Mountain Galaxias, Southern Pigmy Perch

Local. 88^b: 1 species. **Birds:** Speckled Warbler

f. Regionally restricted fauna (R5 species)

Local. 88^b: 4 species. **Birds:** Painted Button-quail, White-winged Chough. **Reptiles:** Delicate Skink, McCoy's Skink

Local. 88^a: 2 species. **Birds:** Long-billed Corella. **Reptiles:** Delicate Skink

Local. 88^c: 3 species. Long-billed Corella. **Reptiles:** Delicate Skink. **Frogs:** Common Spadefoot Toad

Outlook

The faunal significance (particularly of ground and shrub layer species) may decline as insufficient revegetation is occurring on the grazing lands. Poor streamway management along Running Creek is threatening the native fish

FAUNA

Please note. Fauna trapping and intensive bird/herpetofauna surveys were not conducted in the site. The foothills of the Sherwin Ranges were only briefly visited. At least 30 additional forest bird and 6 bat and herpetofauna species would likely occur in this section of the site.

Rare Or Threatened Fauna

Bc **88^d: Mountain Galaxias and Freshwater Blackfish.** The galaxias and Southern Pigmy Perch were recorded in Running Creek upstream of Brennan Avenue East in May 1992. Only small populations are present due to the degraded nature of the creek. The Freshwater Blackfish was recorded by a local resident (Bob Trueman pers. comm.). Short-finned Eels are also present in the creek.

Other Significant Fauna

Birds

Ec **88^a: Satin Bowerbird.** A female bowerbird was present in a farm garden on the upper Deep Creek during August and September 1990 (Norma Murphy pers. comm.). This species undertakes an altitudinal movement from the ranges to the foothills between late autumn and early spring. Males and females become solitary or form all male or female feeding flocks. The species was once very common in the orchards of the Arthurs Creek valley. Widespread shooting and poisoning and predation from cats and foxes in combination with clearing and habitat fragmentation of their upland breeding grounds has caused heavy depletion of the population in NEM.

Ee **88^a Australian King-Parrot and Australian Ringneck.** A small flock of king-parrots was present in a farm garden on the upper Deep Creek during winter 1990 (Norma Murphy pers. comm.). In the non-breeding season small numbers descend into the orchard areas of Arthurs Creek from upland breeding grounds. Formerly the Australian King-Parrot was a pest of the apple and pear orchards. The large roadside Yellow Box and Candlebarks (31.1) are excellent nest-trees for parrots, particularly Red-rumped Parrots and Long-billed Corellas.

Feral populations of Australian Ringnecks have established from aviary escapees along the Deep Creek valley. A pair was recorded breeding in a large hollow provided by a Yellow Box on 6 November 1992. They feed on a wide variety of fleshy fruits (e.g. apples and pears, Sweet Briar hips and Hawthorn) and seeds (e.g. grain and thistles). It is unlikely that the ringneck will ever reach pest proportions.

Ee **88^a: Decline of the Rainbow Bee-eater.** The species was common along the Deep Creek in the 1970s but has declined to a few birds by the 1990s. They are likely to become locally extinct if streamway habitat degradation and livestock grazing is ongoing. A pair was recorded nesting in the banks by Deep Creek Road about 1.7 km north of Running Creek Road on 6 November 1992.

Ee **88^b: Speckled Warbler.** One was seen moving amongst Black Wattles in company with a flock of Buff-rumped Thornbills and Weebills near the Streamville entrance of Running Creek Road on 19 December 1989. The area supports remnant Yellow Box-Red Stringybark box-stringybark woodland (11.2), at about its upland limit in NEM.

Ee **88^a: White-winged Triller and Rufous Songlark.** Both of these migratory birds were recorded breeding in a stand of Yellow Box-Candlebark valley forest (31.1) along upper Deep Creek Road on 6 November 1992.

Reptiles and frogs

88^{abc}: Valley forest of Deep and Running Creek roads. The roadside Yellow Box–Candlebark valley forest (31.1) supports the Delicate Skink, Eastern Three-lined Skink and Lowland Copperhead. The Delicate Skink is locally common (e.g. Running Creek Road near the entrance of ‘Streamville’). Species such as the Common Blue-tongued Lizard and Common Spadefoot Toad are typical of volcanic plains grasslands. The occurrence of the spadefoot toad on lower Running Creek Road (approaching its eastern range limit) is influenced by the natural dominance of grasslands under the valley forest and Yellow Box–Red Stringybark box–stringybark woodland (11.2).

This ground fauna is transitional between fauna of the lowland grassland plains and mountain forests (e.g. Common Blue-tongued Lizard of the lowlands and Blotched Blue-tongued of the uplands). Land clearing has probably enabled the range of the Common Blue-tongued to expand into foothill forests, while the range of the Blotched Blue-tongued Lizard has probably contracted. The Stewart Ponds Creek site to the south-west, containing River Red Gums, has an even stronger grassland herpetofauna representation.

Mountain forest birds of the southern escarpment of the Sherwin Ranges. Time constraints prevented faunal survey of the mountain sections. These contain by far the most extensive areas of forest in the site. They connect the Running Creek Headwaters site of Kinglake NP. The southern slopes of the Sherwin Ranges and Lobb Hill contain a forest overstorey but the understorey is grazed by sheep and is dominated by introduced grasses such as Sweet Vernal-grass. These areas would have lower faunal values than Kinglake National Park, but play an important role in the movement of forest species between the park and the Yan Yean and Scrubby Creek catchments. The area would likely contain mountain forest ground fauna such as the Eastern Whipbird, Bassian Thrush and Spotted Quail-thrush. Rare mountain forest birds such as the Barking Owl and Powerful Owl may also be present.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. The only effective habitat link is in the far northern section of the site which adjoins the Running Creek Headwaters site. The southern section, along with others in the unit, contains the most heavily cleared and fragmented links in NEM. A fragmented link between the Kinglake Ranges and Nillumbik Lowland Hills occurs along the Deep Creek.</p>	
<p>Heavy loss of native flora and fauna species through land settlement and clearing. The site once contained some of most extensive stands of Candlebark and Drooping Sheoke in NEM. Belts of these once stretched over the hills and upper valleys. The Grey-crowned Babbler and Bush Stone-curlew occurred throughout these belts. Possibly Red-tailed Black-Cockatoos and Turquoise and Superb parrots were present as well.</p>	<p>Strengthen habitat links. The middle and lower reaches of the Deep, Running and Stewart Ponds creeks contain the most fragmented and degraded streamway habitat links in the outer section of NEM. Improvement of these links through streamway revegetation is a high priority in the Regional Habitat Link Strategy.</p>

The main episode of land clearing occurred between 1850 and 1890. The area would have been one of the richest for vertebrate fauna but the decline has been one of the most dramatic seen in NEM. Forest gully mammals and birds (e.g. gliders and lyrebirds) and ground and shrub layer species (e.g. White-throated Nightjar and Bassian Thrush) have been eliminated from the cleared sections. The Candlebark which once dominated the landscape of the Plenty Upland Hills has been reduced dramatically over the 150 years since land settlement.

Protection of roadside and paddock remnants along Running Creek and Deep Creek roads. The roadsides support stands of Kangaroo Grass, regenerating trees and shrubs and belts of mature valley forest trees. This provides habitat for parrots and reptiles as well as refugias for insectivorous birds. Veteran Candlebark and Yellow Box which provide nest hollows for parrots occur in the adjoining paddocks. Stock exclusion plots to enable regeneration are considered critical, before the old trees die. Protection of the Yarra Gums along Deep Creek Road is required.

Regional Hydrological Strategy

Inadequate stream flow to maintain native instream fauna populations. Mid-catchment clearing and large orchard and farm dams have reduced the summer–autumn flow of the Deep Creek, possibly as much as 80%. The Running Creek Reservoir has had a similar effect on Running Creek. At this time of year the Deep Creek is reduced to shallow pools made turbid by trampling livestock. The high water temperature (also assisted by lack of riparian vegetation) causes dissolved oxygen to drop to critical levels. This is enhanced by algal blooms resulting from water enrichment due to fertiliser and stock faeces. Blooms were occurring in the Deep Creek at Running Creek Road in April 1992. Apart from a few Short-finned Eel, no native fish survive in the creek. Running Creek was walked in early autumn 1988. At this time the reservoir was in operation and the creek had stopped flowing.

Increase summer-autumn rate of water flow of Running Creek. Even though the middle and lower catchments have been heavily cleared, Running Creek is an important lower order stream for native fish, particularly Freshwater Blackfish. Broad-acre farms occupy most of the length of the creek and the turbidity is lower and water quality higher than the more densely settled and intensively farmed Arthurs Creek. Running Creek Reservoir is now contained in Kinglake National Park and no longer has a role in providing town water. A review of the purpose and use of the reservoir should be undertaken.

Poor land management of streamways and declining water quality. The Deep Creek was once an excellent blackfish stream (Murphy 1971). In April 1988 Running Creek upstream of Brennans Road East had stopped flowing and the smaller pools were drying up. One of the deeper pools was fouled by a dead bullock. The lack of fencing provides stock (sheep and cattle) direct access to much of the creek. As a result, the streamways of the Running and Deep creeks contain little native shrub, tree and grass cover and are perhaps the most denuded native landscapes in NEM. Sandstone creek banks are particularly sensitive to erosion. Deep Creek contains some of the most severe bank slumping and undercutting seen in NEM.

The water quality of Running Creek would improve markedly if the streamway was fenced from livestock and revegetated. This would benefit the Freshwater Blackfish (breeding habitat) and Mountain Galaxias and Southern Pigmy Perch (terrestrial food supplies and cover). Arthurs Creek is one of the most important waterways for native fish in NEM. With proper streamway management of the Deep and Running Creeks, the water quality of Arthurs Creek would improve.

A hydrological study to determine the natural stream flow is required. Inadequate summer-autumn stream flow is a serious threat to native fish in the lower reaches of the Arthurs and Running Creeks. The fish fauna lower down the system would profit from the release of water from the reservoir at these times. This would assist in the oxygenation and detoxification of stagnating pools caused by nutrient build-up of fertilisers and stock faeces. Consideration should also be given to the installation of a fish-way in the reservoir and other instream dams or weirs. This would facilitate the movement of migratory species such as the Common Galaxias and Broad-finned Galaxias, which have both been recorded in the Arthurs Creek system. An electrofishing survey of Running Creek is recommended.

Strathewen–Arthurs Creek LandCare group–priority streamway regeneration and rehabilitation works. The most important objective of the group should be to improve the habitat quality of Deep, Running and Arthurs Creeks. This is particularly important given the serious decline in water quality and native fish fauna downstream in the Diamond Creek due to the compounding effects of higher housing density and intensive land-use.

Due to the lower density of properties in the Running Creek catchment, the damage is more diffused (and reversible). Streamway protection work to repair erosion damage along Deep Creek is required. This includes fencing-off the banks from livestock to enable regeneration. Cleared creek frontages will need planting with herbs, shrubs and eucalypts. Farmers in the catchments of the Deep and Running Creeks should be targeted for a land protection and conservation awareness exercise. This land protection and revegetation project is viewed as important at a regional level.

The loss of riparian and bank vegetation has reduced the cover and terrestrial invertebrate food supply for native fish such as the Freshwater Blackfish. Grazing and siltation has also led to the loss of instream vegetation and invertebrate fauna, the food or habitat of native fish and the Platypus (see Arthurs Creek to Strathewen site). These factors are implicated in the decline of the Rainbow Bee-eater as a high component of their diet is of aquatic or riparian insects.

The high turbidity level would restrict the breeding ability of the Mountain Galaxias and Freshwater Blackfish. The eggs of the galaxias are deposited on the cobble substrate of well-oxygenated pebble riffles. The eggs of the blackfish are placed in hollow logs. The silt smothers the eggs and slows or prevents their development. The Freshwater Blackfish population is declining and is locally endangered

Other Issues

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat.

Site 89 La Trobe Downs–Doctors Gully Creek

- Map Reference:** 7922 392357 to 7922 357342 (Doctors Gully Creek); 7922 364339 (Inala on Bannons Road). One minute lat/long grids include 37° 36' x 145° 08' and 37° 37' x 145° 08' to 145° 09'.
- Location/Size:** Catchment of the Doctors Gully Creek from Nutfield to Doreen and contained between Yan Yean Road, Bannons Road and Doctors Gully Road. Approximately 300 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Vic Road reservations along Doctors Gully Road, Creightons Way and Bannons Road. Private: semi-cleared farmland; livestock grazing.
- Landforms:** Foothill (see PUH A). Elevation is 100–218 m (Mt Caroline).

HABITAT SIGNIFICANCE

Assessment: Medium–Category 2

Partially intact and extensive stands: Red Box–Red Stringybark box–stringybark woodland (11.1); Yellow Box–Candlebark valley forest (31.1)

Rare species: Yarra Gum

Notable features: Yellow Box–Candlebark valley forest roadsides along Edward Henty Avenue; scattered Blakely's Red Gums and Hill Manna Gums in the upper reaches of Doctors Gully Creek; White Box, and Silver Bundy were formerly present under Yellow Box–Red Stringybark box–stringybark woodland (11.2) on Mt Caroline; a few Broad-leaved Peppermints occur along Brocks Road.

FAUNAL SIGNIFICANCE: Site 89 La Trobe Downs–Doctors Gully Creek

Assessment: Regional–Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

89^a: 37° 37' x 145° 08'; La Trobe Downs, Bannons Road Yarrambat

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 89^a: 4 Swift Parrots in flowering Red Ironbarks and Yellow Gums at Inala in June 1986

c. Rare fauna

Regional. 89^a: Common Dunnart (breeding)

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

e. Honeyeaters

Regional. 89^a: 8 species including the Fuscous Honeyeater in a 1 ha stand of flowering Red Ironbarks and Yellow Gums at Inala in June 1986

f. Breeding migratory insectivores

Regional. 89^a: 8 species including the Leaden Flycatcher, White-winged Triller and Rufous Songlark in a 2 ha/20-minute count at Inala on 23 November 1986

h. Bats

Regional. 89^a: 7 species trapped at Inala on 19 December 1986

i. Frogs

Regional. 89^a: 6 species at Inala on 18 December 1986

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 89^a: 139 species

b. Native birds

Regional. 89^a: 107 species

c. Native mammals

Regional. 89^a: 13 species

d. Herpetofauna

Regional. 89^a: 19 species

f. Butterflies

Regional. 89^a: 20 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 89^a: 19 species

c. Regionally vulnerable fauna (R2 species)

Regional. 89^a: 4 species. **Birds:** Swift Parrot (flowering Red Ironbarks and Yellow Gums at Inala in June 1986), White-throated Gerygone, Fuscous Honeyeater (flowering Red Ironbarks and Yellow Gums at Inala in June 1986). **Mammals:** Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 89^a: 5 species. **Birds:** Collared Sparrowhawk, Little Corella, Fork-tailed Swift, Masked Woodswallow (breeding near Edward Henty Drive in November 1986), White-browed Woodswallow (breeding)

e. Regionally depleted fauna (R4 species)

Regional. 89^a: 9 species. **Birds:** Australian King-Parrot, Rainbow Bee-eater, Leaden Flycatcher, White-winged Triller, Bassian Thrush, Speckled Warbler, Rufous Songlark. **Reptiles:** Red-bellied Black Snake. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 89^a: 16 species. **Birds:** Painted Button-quail, Royal Spoonbill, Great Egret, Cattle Egret, Little Eagle, Barn Owl, Purple-crowned Lorikeet, Long-billed Corella, White-winged Chough. **Reptiles:** Delicate Skink, Tussock Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad. **Butterflies:** Phigalia Skipper, Dark Purple Azure, Chequered Blue

g. Nesting birds of prey

Regional. 89^a: Collared Sparrowhawk nesting in a Long-leaf Box in the gully on Inala in summer 1985/86

F. POPULATION DENSITY: Viability and Abundance–point census

m. Regionally rare fauna (R3 species)

Regional. 89^a: 3 pair of White-browed Woodswallows nesting in spouts of a dead Long-leaf Box on the property east of Inala in the summer of 1985/86; flocks of 10 to 30 Little Corellas frequently seen at Inala

o. Regionally restricted fauna (R5 species)

Regional. 89^a: flocks of 10 to 30 Long-billed Corellas frequently seen at Inala

Outlook

The faunal significance was Regional Category 3 before the commencement of planting cleared farmland at Inala commenced in 1975. Over the following 12 years 5,000 native trees and shrubs were established. The faunal significance had risen to Regional Category 1 by the time the first Swift Parrots were seen in the Red Ironbark/Yellow Gum plantation in 1986. As the plantations mature they may attain State significance for avifauna diversity and rarity (see conservation measures).

FAUNA

Rare or Threatened Fauna

Bb **89^a: Swift Parrot.** Four birds visited flowering Red Ironbarks and Yellow Gums at Inala in June 1986.

Bc **89^a: Common Dunnart.** Breeding female recorded in a hollow log at Inala.

Other Significant Fauna

Birds

89^a: Inala bird list. The 8 ha property was part of the La Trobe Downs Estate. In 1974, the property contained about 70 original trees, predominantly Red Box, Red Stringybark and Long-leaf Box (box-stringybark woodland; 11.1). There was one Yellow Box and one Hill Manna Gum. Remnant Red Stringybark herb-rich foothill forest (6.1) occurred along a gully (including Thatch Saw-sedge and old Rough Tree-fern stumps). This gully forms one of the tributaries of Doctors Gully Creek which flows into Arthurs Creek at Nutfield. Many of the Red Stringybarks were in a condition of advanced dieback, due to ringbarking by cattle, particularly during the 1967 drought.

The property was revegetated over a 12 year period from 1975 to 1986. Plantings comprised 4 ha of indigenous eucalyptus woodland, a 1 ha Red Ironbark–Yellow Gum plantation, a 1 ha Grey Box woodlot, a 1 ha eucalyptus arboretum and a 0.5 ha ornamental native garden. The property would have originally contained three vegetation communities. Red Box–Red Stringybark box-stringybark woodland (11.1) on the hill-crests and exposed hill-slopes, Yellow Box–Candlebark valley forest (31.1) in the valleys and Red Stringybark herb-rich foothill forest in a gully and adjoining sheltered hill-slope. One hectare each of herb-rich foothill forest and box-stringybark woodland and two of valley forest were established.

89^a: Avifauna recruitment at Inala. The bird list doubled from 55 species in 1975 to 107 species in 1986. Seventy species including 34 breeding species were recorded during a bird census on 23 November 1986. In 1975 the resident native avifauna predominantly comprised timbered farmland species. These included the Australian Magpie, Australian Magpie-lark, Little Raven, White-plumed Honeyeater, Mistletoebird, Yellow-rumped Thornbill, Willie Wagtail, Eastern Rosella, Red-rumped Parrot, Galah, Australian Kestrel, Black-shouldered Kite, Tawny Frogmouth and wintering Flame and Scarlet robins. Breeding migrants included the Pallid Cuckoo and Horsefield's Bronze-Cuckoo. Species present in the grassy paddocks included the Richard's Pipit, Stubble Quail, Barn Owl and Brown Falcon. Only 10 species of forest birds were resident including the Rufous Whistler, Grey Currawong, Grey Shrike-thrush and Dusky Woodswallow.

The first noticeable change occurred in the house block and gully and valley to the north in 1978, when the trees had grown to 4 or 5 m tall. Species extended their range, presumably from the bushland to the south of Bannons Road, many remaining to breed. These included the Painted Button-quail, White-winged Chough, Striated Thornbill, Buff-rumped Thornbill, Weebill, Black-faced Cuckoo-shrike, Varied Sittella, Crested Shrike-tit, Spotted Pardalote, Golden Whistler and Australian King-Parrot (winter visitor). The Common Bronzewing, Speckled Warbler and Yellow Thornbill moved into the copses of Black and Golden Wattles. The Brown Thornbill, Silvereeye, New-holland Honeyeater, White-naped Honeyeater, Yellow-faced Honeyeater, Red Wattlebird and Eastern Spinebill were recorded in shrubs in the house block.

The Masked Lapwing (breeding), Australian Wood Duck (breeding), Pacific Black Buck, Little Pied and Little Black cormorants, Royal and Yellow-billed spoonbills, White-faced and White-necked herons and Great Egret were each recorded on the paddock dams. By 1980, the Golden Whistler, Grey Fantail, Grey Shrike-thrush and Yellow-faced, Brown-headed and White-naped honeyeaters commenced nesting in the tree canopies and shrub thickets in the house block and the gully. These birds along with the thornbills attracted the Fan-tailed Cuckoo and Shining Bronze-Cuckoo.

A Red Ironbark and Yellow Gum plantation of 1 ha was established near Bannons Road in 1978. The section along the ridgeline near the road was planted with the two local species (*E. tricarpa* and *E. leucoxydon* ssp. *pruinosa*). These flower in autumn and winter. The section downslope was planted with the New South Wales Mugga (*E. sideroxydon*) and the South Australian Blue Gum (*E. leucoxydon* subspecies). These flower from late winter to late spring.

The Red Ironbarks and Yellow Gums started flowering consistently after about 10 years (1986) and several new nectar feeders were observed. These included the Brown-headed, White-eared, Fuscous and Crescent honeyeaters, Musk and Purple-crowned lorikeets and Swift Parrot. The stand, then averaging 6 to 7 m height, also supported 30 to 40 Weebills and Yellow Thornbills. It is anticipated that as the trees mature their combined flowering seasons will attract additional honeyeater species recorded nearby in the Plenty Gorge. These may include the Yellow-tufted, Black-chinned and Regent honeyeaters.

By 1986, the established valley forest in the valley and adjoining herb-rich foothill forest of the gully had attracted several new breeding species. These included the Brown Goshawk, Collared Sparrowhawk, Australian Owlet-nightjar, Eastern Yellow Robin, Superb Fairy-wren, Leaden Flycatcher, White-winged Triller, White-throated Gerygone, Rufous Songlark, White-throated Treecreeper and Olive-backed Oriole. A Bassian Thrush in the Burgan thickets of the gully and a Southern Boobook were seen for the first time in May 1986.

89^a: Rainbow Bee-eater. Locally common in the 1970s, they nested until the early 1980s in the banks of the middle reaches of Doctors Gully Creek (remnant Swamp Gum gully woodland; 10.3). Since that time they have declined and have only been seen in passage.

Reptiles and frogs

89^a: Diverse herpetofauna assemblage. Nineteen species have been recorded. The site contains the plains/hills species overlap which characterises sites bordering the volcanic plains in the Plenty Hills (see Stewart Ponds Creek and Deep Creek–Running Creek sites). This includes the uncommon overlap of the Tussock Skink of the grassy plains with the Delicate and Weasel Skinks of the foothill forests.

Butterflies

89^a: Inala. Twenty species recorded in 1986. Significant species: Phigalia Skipper (breeding in Wattle Mat-rush); Phigalioides Skipper (breeding in Small-flowered Mat-rush on Bannons Road frontage); Common Imperial Blue (colonised a stand of four to five year old Black Wattles); Dark Purple Azure (breeding in Creeping Mistletoe on Red Box); Chequered Blue (breeding on a garden saltbush); and Dingy Swallowtail (breeding on the garden lemon tree).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. No effective internal and external habitat links. Partial links for birds persist through treed farmland and along roadsides and creeks connecting the Plenty Gorge Yarrambat, Hurstbridge to Arthurs Creek and Plenty River–Diamond Creek Link sites.</p>	
<p>Land clearing. Loss of native flora and fauna species has occurred since land settlement Three habitat types in the site have been effectively eliminated. These include Red Stringybark herb-rich foothill forest (6.1), Swamp Gum gully woodland (10.3) and Yellow Box–Long-leaf Box box–stringybark woodland (11.2). Each of the other habitats are partially degraded and fragmented. See the Deep Creek–Running Creek site.</p>	<p>Strengthen habitat links.</p> <p>Protect stands of Yellow Box and Kangaroo Grass. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat (e.g. Doctors Gully Creek catchment). A system of stock exclusion plots would protect the herb layer and allow natural regeneration of shrubs and trees.</p>
Other Issues	
<p>Incongruous public road reserve management. Roadside verges contain some of the Shire of Nillumbik’s rarest plant communities. There are important roadside verges in this site along Bannons Road, Creightons Way and Edward Henty Avenue. The issue is raised in this site but could be validly raised in most sites in the foothills and plains of NEM. It is widely known that people from the city drive out to areas such as Bannons Road to look at the magnificent views and wildflower displays.</p>	<p>Roadside management in the Shire of Nillumbik. The Shire has undertaken a survey of roadsides for significant native vegetation and weeds. A review of earthwork procedures has also been undertaken. Significant areas have been mapped and accordingly protected (e.g. weed control).</p>

Some recent examples of roadside degradation in the Plenty Upland Hills include:

- Elimination of grassland and the few remaining Yellow Box during sealing/widening of the Yan Yean–Arthurs Creek Road near Deep Creek Road (see Deep Creek–Running Creek site).
- Slashing/grading important wildflower areas adjoining Yan Yean Reservoir along Ridge Road near Deep Creek Road (see Ridge Road–Sherwin Range Catchment–Reference Area site).
- Sealing/widening the Hurstbridge–Arthurs Creek Road near Boyds Road Midhurst (for several months highly turbid earthworks runoff entered the significant adjacent section of Arthurs Creek; see Hurstbridge–Arthurs Creek site).
- Sealing/widening of Bannons Road North, particularly an important section of grassland near Boyds Road (containing rare plants/butterflies; see Hurstbridge–Arthurs Creek site).
- Degradation of the significant reserve along Haleys Gully Road near Bannons Road North by horse riders and the invasion of weeds such as Flax-leaf Broom and Sweet Pittosporum (see Haleys Road Red Ironbarks site).

The road reserves of Bannons Road North and Boyds Road contain the Small Grass-tree and a very rare butterfly, known as the Rare White-spot Skipper (recorded in only one other location in NEM). The larvae of this skipper breed on Wattle Mat-rush and the adults feed on nectar from the Common Rice-flower. Both plant species grow (in abundance before the earthworks) on the road reserve. Until rehabilitation and planting occurred several months later, the works on the west side of Bannons Road were left to erode. Weeds replaced native herbs and loose soil was left in piles in several sections. Muddy runoff from the bare soil found its way into Arthurs Creek, leading to further siltation and degradation of the instream ecosystem.

The Revegetation of Inala

The main objectives were to establish stands of each of the 18 eucalyptus species occurring within a 2 km radius of the property and to create a year-round nectar attraction for honeyeaters. The 5000 native trees and shrubs established between 1975 and 1986 included 4 ha of indigenous woodland and 1 ha of woodlot, 1 ha ironbark plantation, 1 ha eucalyptus arboretum and 0.5 ha ornamental native house garden. The first stage of revegetation included 1 ha of Red Stringybark herb-rich foothill forest in the central gully. Narrow-leaf Peppermint, Swamp Gum, Messmate and Yarra Gum were planted while three of the local species (Red Box, Long-leaf Box and Red Stringybark) were self-regenerating. The gully erosion was halted and shrubs including Golden Wattle, Black Wattle, Burgan, Sweet Bursaria and Hop Goodenia were established.

The second stage was 1 ha of Yellow Box–Candlebark valley forest on the exposed valley fronting the gully. The third stage was 1 ha of Red Box–Red Stringybark box–stringybark woodland on a central ridgeline and saddle. The final stage was 1 ha of Yellow Box–Candlebark valley forest in the back paddock. This included White Box, which formerly occurred on Mt Caroline.

From the outset, a balance between keeping the grass down for fire prevention and establishing revegetation areas had to be obtained. Cattle grazed the property for about four years. Over the 12 years, successive stages were undertaken by establishing temporary stock exclosures. In 1975 a stock exclosure of 1 ha was erected in the centre of the property containing the severely eroded gully. A narrow strip of land between this and the house block was kept open to cattle to create a firebreak. The grass was slashed for three years while the stand established.

When the saplings had reached 4 to 5 m by 1978, the fence was taken down and moved to establish the ironbark plantation on Bannons Road. Cattle stripping and ringbarking the saplings in the gully resulted in a changeover to horse agistment. Three or four horses kept the grass down and left the saplings alone. The central ridge and saddleback was planted in 1981. It did not require fencing as the saplings were protected from trampling amongst the tussocks. The back paddock was planted in 1985–86. The final objective of maintaining the property as a farmllet, while establishing a significant conservation and natural resource area, had been achieved.

Site 90 Stewart Ponds Creek

- Map Reference:** 7922 392361 to 7922 384404 (Stewart Ponds Creek); 7922 385392 (Arthurs Creek Cemetery). One minute lat/long grids include 37° 34' x 145° 09' to 145° 10', 37° 35' x 145° 08' to 145° 09' and 37° 36' x 145° 09'.
- Location/Size:** Catchments of the Stewart Ponds Creek from upstream of Arthurs Creek to upstream of Arthurs Creek Road. Approximately 400 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Vic Road reservations (e.g. Middle Hut Road, Arthurs Creek Road, Deep Creek Road and Running Creek Road). Private: Arthurs Creek Cemetery; cemetery trust); General Farming and farmland; livestock grazing.
- Landforms:** Foothill (see PUH A). Elevation is 100–202 m (Arthurs Creek Cemetery).

Scientific and Educational Values

Scientific reference. Valley forest/gully woodland census plots along Middle Hut Road: 1000 m south of Chapel Road (southern point of lower Stewart Ponds Creek plot); and 300 m north of Chapel Road (middle Stewart Ponds Creek plot).

HABITAT SIGNIFICANCE

Assessment: Medium–Category 2

Partially intact and extensive stands (lower Stewart Ponds Creek): Manna Gum gully woodland (10.1); Yellow Box–Red Stringybark box–stringybark woodland (11.2); Yellow Box–Candlebark valley forest (31.1)

Rare species: Yarra Gum

Notable features: Remnant stands of Yellow Box–Candlebark valley forest along Middle Hut Road and Brocks Road. The management unit originally supported extensive stands. Some areas on farmland (Middle Hut Road) support a Kangaroo Grass-dominated field layer (tree/shrub layers depleted by livestock grazing). The trees contain ample nesting hollows. Remnant grassland (ex-Yellow Box–Red Stringybark box–stringybark woodland; 11.2) at Arthurs Creek Cemetery. Three Snow Gums at the Stewart Ponds Creek crossing of the Yan Yean–Arthurs Creek Road.

FAUNAL SIGNIFICANCE: Site 90 Stewart Ponds Creek

Assessment: Regional–Category 3 (C, D, E)

Reference grids for the significance keys include:

90^a: 37° 34' x 145° 10'; Arthurs Creek Cemetery/upper Stewart Ponds Creek

90^b: 37° 35' x 145° 09'; middle Stewart Ponds Creek/Middle Hut Road

90^c: 37° 36' x 145° 09'; lower Stewart Ponds Creek/Middle Hut Road

c. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Local. 90^b: 6 species in October 1989 including the Rufous Songlark at the middle Stewart Ponds Creek bird census plot

j. Reptiles

Regional. 90^c: 6 species on 17 October 1989 including the Delicate Skink, Tussock Skink, Tiger Snake and Eastern Brown Snake in a 60-minute herpetofauna search in the Themeda grassland paddock to west of the lower Stewart Ponds Creek bird census plot

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

b. Native birds

Regional. 90^c: 51 species

f. Butterflies

Local. 90^b: 15 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 90^b: 4 species. **90^c:** 2 species

c. Regionally vulnerable fauna (R2 species)

Regional. 90^c: 1 species. **Birds:** Crested Pigeon; seen on the lower Stewart Ponds Creek census plot (800 m south of Chapel Road) on 11 October 1989

e. Regionally depleted fauna (R4 species)

Regional. 90^b: 4 species. **Birds:** Rainbow Bee-eater, Rufous Songlark. **Reptiles:** White's Skink
Butterflies: Small Copper

Local. 90^c: 1 species. **Birds:** Rainbow Bee-eater

f. Regionally restricted fauna (R5 species)

Local. 90^b: 5 species. **Birds:** Long-billed Corella. **Reptiles:** Delicate Skink, Tussock Skink. **Frogs:** Common Spadefoot Toad.

Local. 90^a: 2 species. **Reptiles:** Common Long-necked Tortoise, Delicate Skink

Local. 90^c: 3 species. **Birds:** Long-billed Corella. **Reptiles:** Delicate Skink, Tussock Skink

F. POPULATION DENSITY: Viability and Abundance–point census

n. Regionally depleted fauna (R4 species)

Unranked. 90^c: half dozen breeding pairs of Rainbow Bee-eaters along the lower Stewart Ponds Creek (downstream of Chapel Road) in 1978

Outlook

The faunal significance would improve from Regional Category 3 to 2 with grazing exclusion, land protection and revegetation works along the creek, its tributary gullies and on the grassland areas and adjoining uncultivated paddocks of Middle Hut Road. Broad-acre farm subdivision could lead to further habitat deterioration.

FAUNA

Other Significant Fauna

Birds

Ec **90^c: Crested Pigeon at lower Stewart Ponds Creek.** This species may be undergoing a range expansion from between Mernda and Yan Yean in the Plenty Valley. It was seen on the lower Stewart Ponds Creek census plot (800 m south of Chapel Lane) on 11 October 1989. The uncultivated grasslands dominated by Kangaroo Grass along Middle Hut Road form one of the best areas in the hills of NEM for the Stubble Quail. Farm subdivision, cultivation of broad-acre paddocks and high stock grazing rates would

deplete local populations of the quail. Much could be done to improve the habitats of these species (see conservation measures).

Ed 90^c: Decline of the Rainbow Bee-eater. Three colonies involving a dozen breeding birds, occurred along the lower Stewart Ponds Creek (downstream of Chapel Road) in 1978. Only one colony of four birds was located in 1989. None were present in 1990.

90^b: Valley forest/gully woodland bird census: middle Stewart Ponds Creek. Ten 2 ha/20-minute counts were conducted in October 1989/90. The census was a 2 ha stand of open woodland situated on the west side of Middle Hut Road, about 300 m north of Chapel Road.

Degree of fragmentation: high (a small and isolated roadside stand and adjacent cleared paddocks). This was the most fragmented of the 16 valley forest/gully woodland census plots. A dry creek containing scattered trees but cleared of shrubland vegetation crossed the south end of the transect. The plot was more than 2 km from the nearest block of woodland. Degree of thinning: high (tree density of 72/ha). Degree of understorey and ground degradation: the road verge contains an intact field layer and scattered tall shrubs).

Vegetation. The road frontage supported Yellow Box–Candlebark valley forest (31.1) while fragmented Swamp Gum gully woodland (10.3) occurred in the dry creek. Trees/ha (10% cover): 47 Narrow-leaf Peppermint, 20 Candlebark, 4 Yellow Box and 1 River Red Gum. Tall shrubs (10% cover); low shrubs (5% cover); herbs (70% cover).

Results. Bird summary: 40 species and 624 individuals recorded (2 forest, 16 woodland, 7 shrubland and 15 fragmentation species); 31.2 birds/ha composed of 0.5 (2%) forest, 10.9 (35%) woodland, 5.1 (16%) shrubland and 14.7 (47%) fragmentation species

Forest species with densities exceeding 0.5/ha included the Rufous Whistler (0.5)

Woodland species with densities exceeding 0.5/ha included the Tree Martin (2.8), Striated Pardalote (2.2), White-plumed Honeyeater (1.3), Eastern Rosella (1.2), Black-faced Cuckoo-shrike (1.0) and Red-rumped Parrot (0.7)

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (3.0), Grey Fantail (1.3), Grey Shrike-thrush (1.1) and Silvereeye (1.0)

Fragmentation species with densities exceeding 0.5/ha included the Common Starling (5.2), Australian Magpie (1.7), Common Myna (1.7), Yellow-rumped Thornbill (1.2), Welcome Swallow (1.0), Noisy Miner (1.0), Little Raven (0.7), Eurasian Tree Sparrow (0.6) and Australian Magpie-lark (0.6)

Parrots: 2 species and 1.9 birds/ha. **Canopy insectivores–migratory:** 7 species and 4.7 birds/ha; **non-migratory:** 2 species and 3.4 birds/ha

Discussion. 31.2 birds/ha, 8.1 of which were canopy insectivores (dieback control agents). This is a poorest representation of canopy insectivores of the 16 census plots. The plot averaged only one forest bird per census. Shrubland birds were also poorly represented. The Yellow Thornbill consisted of over half of these (see lower Stewart Ponds Creek plot). Woodland species were highly represented as Yellow Box had been thinned and Candlebark was dominant. This influenced the presence of the Tree Martin, Red-rumped Parrot and Long-billed Corella. Rainbow Bee-eaters were present nearby along the creek and were recorded flying through the plot on several occasions.

Conclusion: the clearing of bushland and lack of habitat links has resulted in a paucity of forest birds and the high frequency of fragmentation species. The stand no longer contains representative valley forest avifauna.

90^c: Valley forest/gully woodland bird census: lower Stewart Ponds Creek. Ten 2 ha/20 minute counts were conducted in October 1989/90. The census plot was a 1000 m transect 20 m wide along Middle Hut Road, heading south from Chapel Road.

Degree of fragmentation: high (surrounded by farmland, connecting roadsides). A dry creek containing scattered trees but cleared of shrubland vegetation crossed the south end of the transect. The plot was more

than 2 km from the nearest block of woodland. Degree of thinning: high (tree density of 106/ha). Degree of understorey and ground degradation: medium (moderately intact road verges; adjacent paddocks and timbered slopes).

Vegetation. The road frontage supported Yellow Box–Candlebark valley forest (31.1) while fragmented Swamp Gum gully woodland (10.3) occurred in the eastern gully. Trees/ha (15% cover): 30 Candlebark, 28 Long-leaf Box, 18 Red Stringybark, 20 Narrow-leaf Peppermint and 10 Yellow Box. Tall shrubs: (10% cover); low shrubs: (5% cover); herbs (70% cover).

Results. Bird summary: 42 species and 556 individuals recorded (6 forest, 14 woodland, 8 shrubland and 14 fragmentation species); 27.8 birds/ha composed of 3.6 (13%) forest, 8.2 (29%) woodland, 5.6 (20%) shrubland and 10.2 (38%) fragmentation species

Forest species with densities exceeding 0.5/ha included the Striated Thornbill (1.0), Spotted Pardalote (0.9), Varied Sittella (0.6) and Weebill (0.5)

Woodland species with densities exceeding 0.5/ha included the Striated Pardalote (2.5), Eastern Rosella (1.2), White-plumed Honeyeater (1.1), Red-rumped Parrot (0.8), Dusky Woodswallow (0.7) and Tree Martin (0.6)

Shrubland species with densities exceeding 0.5/ha included the Yellow Thornbill (3.1), Pallid Cuckoo (0.7), Red-browed Firetail (0.6), Grey Fantail (0.5) and Superb Fairy-wren (0.5)

Fragmentation species with densities exceeding 0.5/ha included the Common Starling (2.6), Common Myna (1.8), Australian Magpie (1.4), Little Raven (1.4), Yellow-rumped Thornbill (1.2), Willie Wagtail (0.6) and Welcome Swallow (0.5)

Parrots: 2 species and 2.0 birds/ha.

Canopy insectivores–migratory: 6 species and 2.6 birds/ha; **non-migratory:** 5 species and 6.0 birds/ha

Discussion. 27.8 birds/ha, 8.6 of which were canopy insectivores (dieback control agents). This is a poor representation of canopy insectivores, particularly the forest thornbills and cuckoos. This would be attributed to a lack of effective habitat links. Shrubland birds, particularly the flycatchers, were poorly represented. Yellow Thornbills comprised more than 50% of this group. In NEM, Yellow Thornbills occur where the tree layer (exceeding 10 m) occupies less than 20% cover and the tall shrub layer of Black Wattle or low eucalypts occupies more than 10% cover. They are consequently a common roadside species. They are an important foster parent for the Pallid Cuckoo.

The mature Candlebarks influenced the presence of woodland species including the Tree Martin, Rufous Songlark, Red-rumped Parrot and Long-billed Corella. A Crested Pigeon was seen on 11 October 1989. Only two observations were made of this species east of the Plenty River in NEM.

Conclusion. Land clearing and loss of effective habitat links has substantially reduced the forest birds and increased the fragmentation birds.

Reptiles and frogs

Ee **90^b: White's Skink in roadside grassland of Middle Hut Road.** One was seen in the *Themeda* grassland (ex Yellow Box–Candlebark valley forest; 31.1) north of Chapel Lane on 11 October 1989.

Ef **90^{bc}: Tussock Skink, Delicate Skink and Common Spadefoot Toad in roadside grassland of Middle Hut Road.** The occurrence of the Tussock Skink and the *Themeda* grassland habitat along Middle Hut Road is about as far as each extends from the Quaternary volcanic plains in NEM. The Delicate Skink is a foothills species; it also occurs at the Arthurs Creek Cemetery. The two species of skinks seldom co-occur. Other plains grassland faunal species present include the Common Spadefoot Toad.

Butterflies

90^b: Middle Stewart Ponds Creek. Fifteen species recorded during the 1989/1990 October bird census. Significant species: Common Dusky Blue (breeding in the Downy Dodder-laurel along the roadside of Middle Hut Road), Common Imperial Blue (large population breeding in dwarf Black Wattles along the roadside of Middle Hut Road) and Small Copper (breeding in wood-sorrel along the roadside of Middle Hut Road).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Apart from the lower section of Stewart Ponds Creek which connects the Hurstbridge to Arthurs Creek site, no effective internal or external habitat links remain.	
Loss of native vegetation through over-clearing and further degradation from land-use. See management unit description and the Hurstbridge to Strathewen management unit.	Strengthen habitat links. The middle reaches of the Stewart Ponds Creeks contain some of the most fragmented and degraded habitat links in the outer section of NEM. Improvement of these links through streamway revegetation is a high priority in the Regional Habitat Link Strategy.
	Increase protection of the broad-acre grassland of the Stewart Ponds Creek catchment. Farm intensification including cultivation of broad-acre paddocks and increasing stock grazing rates is contributing to the local elimination of grassland fauna such as the quails. Native grassland paddocks along Middle Hut Road should be protected from cultivation. Areas should be fenced from livestock to protect the grassland herbs and enable shrub and tree regeneration. Most of the paddock trees are old and dying.

	<p>Grassland Reserve and management of road reserves along Middle Hut Road. The regionally significant grassland area north of Chapel Road needs to be protected. Woody weeds including the Gorse and Montpellier Broom need to be removed. Invasive grassy weeds, particularly Sweet Vernal-grass also need control. The section requires a fence as trail-bike and horse riders are causing ground disturbance.</p>
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Regional Hydrological Strategy

Poor land management of streamways. See the Deep Creek–Running Creek site and the Hurstbridge to Strathewen management unit.

Water salinity in Stewart Ponds Creek. The salinity of Arthurs Creek rises markedly downstream of Stewart Ponds Creek. The floodplain of the Stewart Ponds Creek contains several saline indicator plants including Spiny Rush (a noxious weed) and Sea Barley-grass. The removal of native vegetation from the steep hills and slopes has greatly increased the volume and rate of surface water runoff into gullies and subsequent gully erosion (see volume 1).

Siltation. Land clearing, heavy grazing and altered runoff and drainage patterns have eroded topsoil from elevated areas and deposited it in low-lying flats, depressions and drainage lines. Narrow streams such as Arthurs Creek, which formerly contained clear running water and deep holes, have become wide, shallow, muddy tracts with intermittent flows. Tributaries such as the Stewart Ponds Creek have become muddy waterholes with heavily eroded banks. Siltation restricts breeding opportunities for some native fish (see volume 1).

Land protection and salinity management in the Stewart Ponds Creek catchment. The streamway and tributary gullies of Stewart Ponds Creek need urgent protection. The creek banks are highly eroded and need to be fenced to restrict livestock access. This is necessary to rehabilitate the banks and for natural revegetation and replanting to occur. It may also save the Rainbow Bee-eater from local extinction. The Stewart Ponds has an intensive pastoral history. The future holds an even more intensive need for revegetation and land protection.

The salinity of Stewart Ponds Creek and its causes require investigation. These are likely to be heavy land clearing and livestock grazing of the streamway and gully catchments. Land-use in recharge areas of the catchment should be looked at closely. Headwater gullies should be fenced off from livestock and revegetated. This has recently been undertaken in the gully by the lower Stewart Ponds Creek census plot on Middle Hut Road (Sandy Brock pers. comm.). Catchment farmers should be targeted for a conservation awareness exercise and assistance in land protection.

 Other Issues

Arthurs Creek Cemetery. Until about a decade ago, most burials were of descendants of the early settlers. A broader policy in recent years has led to expansion of burials in the cemetery. With each new grave, a band of weeds (particularly grasses such as Sweet Vernal-grass and Brown-top Bent) spreads into the grassland. The grassland is being eliminated. The vulnerable Clover Glycine in the southern section of the cemetery was eliminated in the early 1990s. The small areas of grassland are being replaced by weedy swards. Many of the orchids (particularly greenhoods) have declined over the last 15 years due largely to slugs coming from the surrounding paddocks and the rank herbage and rubble around the graves. The presence of snakes requires annual mowing of the grass but this is slowly eliminating the significant grassland species.

Grassland management at the Arthurs Creek Cemetery. The native wildflowers at the cemetery provide a tranquil setting and many people derive great enjoyment and inspiration from them. The cemetery is a significant grassland area and should be protected accordingly. Burials should be confined to the existing disturbed areas. An alternative site is required, preferably through acquisition of a small area of pasture land adjoining the cemetery.

Consideration should be given to burning small sections. Plant responses should be scientifically monitored. Management should also consider weed control by hand removal, weed burner or careful application of user-friendly herbicides. The Arthurs Creek LandCare group needs to become involved with plant management at the cemetery. Some of the rare plants require propagation. A friends group for the cemetery and some financial or technical support from NRE or the Nillumbik Shire would be desirable.

Implementation of Native Vegetation Clearance Controls on private land. This should contain restrictions on land clearing, cultivation and excessive grazing of significant habitat. This relates to areas designated within the site and surrounding undesignated areas lying within the management unit.

PUH B YAN YEAN RESERVOIR AND CATCHMENT

This management unit consists of one site of state faunal significance (site 92) and one of regional faunal significance (site 91) and surrounding land that forms habitat links.

Map Reference: 7922 359398 (southern point, 3.5 km north of Doreen); 7922 385501 (northern point, 5.5 km north-east of Whittlesea).

Location/Size: The unit forms a wedge of land stretching from below the reservoir wall at the corner of Arthurs Creek Road and Recreation Road Yan Yean, north-east to the top of the Sherwin Range (west of Howat Lookout) and north to Eastern Hill on the outskirts of Whittlesea. Sections of Ridge, Coomes and Yan Yean Catchment Track 1 mark the eastern and northern boundaries. Approximately 2800 ha.

Municipality: City of Whittlesea

Physical Features

The management unit lies in the upland hills of the Eastern Uplands.

Landforms

Mountain: plateau/spur, slopes, ridges and gullies. Foothill: ridges, hill-crests, bluffs, hill-slopes, plain-slopes, valleys, gullies, flats (outwash plains), creeks and floodplains, swamps and a permanent water storage reservoir (impoundment). Elevation is 180–500 m.

Hydrology

The reservoir contains extensive areas of shallows (< 2 m depth) in the northern and eastern arms and has an average depth of 5.5 m, reaching about 9 m at its deepest point out from the wall (Bruce Saunders pers. comm.). The normal waterbody area is 520 ha. The substrate around the edges is paved with basalt cobbles and pitchers. Submerged herbfields are present where the depth is less than 1 m. The watercourses within the catchment are ephemeral and channelised. They drain through low-lying flats before entering the reservoir. The reservoir was built on the eastern section of a marshland of 1840 ha (Ryder Swamp) separated by two large bluffs (Kenna 1988).

The main water source is from the Toorourrong to Yan Yean Aqueduct. A 3 km aqueduct (1.2 m depth) was built which diverted the Plenty River from below the confluence of the Bruces Creek downstream of Whittlesea. This enters a bluestone inlet tunnel of 2.5 m diameter and 403 m length on the west side of the reservoir (Kenna 1988). The tunnel runs through the northern bluff separating the reservoir from the river. With the construction of Yan Yean Reservoir, the rate of flow of the Plenty River dropped dramatically (possibly to less than 20%). The commissioning of Toorourrong Reservoir, Wallaby Creek Aqueduct and the aqueduct extension from Toorourrong to link the Yan Yean aqueduct and supersede the diversion of water from the Plenty River below Whittlesea occurred in 1885.

Rainfall: 660–800 mm.

Site 91 Ridge Road–Sherwin Range Catchment– Reference Area

Map Reference:	7922 381453 (Ridge Road at Track 4). 7922 373425 (Yan Yean South Reference Area). One minute lat/long grids include 37° 31' x 145° 09' to 145° 10', 37° 32' x 145° 09' to 145° 10' and 37° 33' x 145° 10'.
Location/Size:	Catchment east of Yan Yean Reservoir. Approximately 1000 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: water storage catchment (Melbourne Water). The site contains Yan Yean North Reference Area (83 ha) and Yan Yean South Reference Area (223 ha).
Landforms:	Mountain and foothill (see PUH B). Elevation is 200–500 m.

Natural Heritage Values

Landscape. The Yan Yean Reference Areas are proclaimed within the Victorian Reference Area System. The section of the reference areas south of Ridge Road contains the rarely preserved foothills woodlands element of the Eastern Uplands. The management of the site since inception of the reservoir has been highly favourable for the conservation of flora and fauna species, particularly relating to issues of restricted access, little intervention from humans and protection from catchment timber harvesting and settlement.

The site provides a significant contact point of mountain and plains vegetation communities. For example, gullies in the east contain the upland Tall Sedge–Sword Tussock-grass herbfield alliance associated with Messmate–Narrow-leaf Peppermint gully woodland (10.2), while flats in the west contain the lowland Rush Sedge–Common Tussock-grass alliance associated with River Red Gum grassy woodland (14.3).

Scientific and Educational Values

Scientific reference. Yan Yean North and South Reference Areas (MMBW 1984). Proposed Grassy Woodland Ecological Reference Area (ERA).

HABITAT SIGNIFICANCE

Assessment: Very High–Category 1

Reference stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark grassy woodland (14.6); Snow Gum grassy woodland (14.7)

Relatively intact and extensive stands: Messmate damp sclerophyll forest (4.2); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Brod-leaved Peppermint heathy forest (8.1); Messmate gully woodland (10.2); Swamp Gum gully woodland (10.3)

Partially intact or small stands: Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Yellow Box–Candlebark valley forest (31.1)

Endangered species: Large-fruit Groundsel

Vulnerable species: Matted Flax-lily, Purple Diuris, Clover Glycine

Rare species: Corkscrew Spear-grass, Slender Tick-trefoil, Yarra Gum, Creeping Grevillea

Critical assemblages or populations: Grassy Woodland Ecological Reference Area. Strategic Habitat Link. Snow Gum–Yarra Gum grassy woodland reference stand. Lowland populations of Snow Gum are disjunct in Victoria and are securely reserved only at Yan Yean and the Brisbane Ranges. The sub-community is endemic to the Melbourne area and its disjunct occurrence at Yan Yean Reservoir is of

considerable biogeographical significance. It contains many rare and disjunct species. These include representatives of plains grassland (e.g. the regionally endangered Plain Quillwort, Large-fruit Groundsel and Clover Glycine), as well as representatives of alpine areas (e.g. the regionally endangered Snow Gum and regionally vulnerable Field Daisy). The reference area supports one of few reserved viable populations of the Yarra Gum and Clover Glycine in southern Victoria and has a high regionally threatened plant diversity (over 25 species)

FAUNAL SIGNIFICANCE: Site 91 Ridge Road–Sherwin Range Catchment–Reference Area

Assessment: State–Category 3 (D); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

91^a: 37° 31' x 145° 10'; Yan Yean Water Catchment–Ridge Road

91^b: 37° 31' x 145° 11'; Yan Yean Water Catchment–Coombs Road

91^c: 37° 32' x 145° 09'; Yan Yean Water Catchment–South Reference Area

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 91^a: Brush-tailed Phascogale, Common Dunnart

Regional. 91^b: Powerful Owl,

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

h. Bats

Regional. 91^a: 5 species by Track 4 north of Ridge Road on 12/13 April 1988;

Regional. 91^b: 4 species including the Gould's Long-eared Bat, Great Pipistrelle and Southern Forest Bat on the section bordering Humevale fire track, west of Coombs Road on 13 April 1988

i. Arboreal mammals

Regional. 91^b: 5 species spotlight including the Koala, Mountain Brushtail Possum, Greater Glider and Sugar Glider on the section near Humevale fire track, west of Howat Lookout/Coombs Road on 13 April 1988

j. Ground mammals

Regional. 91^b: 5 species including the Brown Antechinus and Bush Rat (both taken in Elliott traps) on the section bordering Humevale fire track, west of Coombs Road on 13 April 1988

l. Reptiles

Regional. 91^b: 8 species including the White's Skink, McCoy's Skink, Coventry's Skink and Southern Grass Skink on the section bordering Humevale fire track, west of Coombs Road on 25 November 1988

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 91^a: 80 species

b. Native birds

Regional. 91^a: 52 species

Local. 91^b: 33 species

c. Native mammals

Regional. 91^a: 16 species

Regional. 91^b: 15 species

d. Herpetofauna

Regional. 91^a: 12 species**Regional. 91^b:** 13 species

f. Butterflies

Regional. 91^a: 27 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 91^a: 5 species**Local. 91^b:** 13 species

b. Regionally endangered fauna (R1 species)

Regional. 91^c: 1 species. **Birds:** Peaceful Dove (breeding)

c. Regionally vulnerable fauna (R2 species)

Regional. 91^a: 1 species. **Birds:** White-throated Nightjar,**Regional. 91^b:** 3 species. **Birds:** Cicadabird. **Mammals:** Brush-tailed Phascogale, Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 91^a: 2 species. **Birds:** Spotted Quail-thrush. **Mammals:** Gould's Long-eared Bat**Regional. 91^b:** 6 species. **Mammals:** Mountain Brushtail Possum, Greater Glider, Eastern False Pipistrelle, Gould's Long-eared Bat. **Reptiles:** Coventry's Skink, Southern Grass Skink**Regional. 91^b:** 1 species. **Birds:** White-browed Woodswallow

e. Regionally depleted fauna (R4 species)

Regional. 91^a: 2 species. **Birds:** Superb Lyrebird. **Butterflies:** Spotted Brown**Regional. 91^b:** 4 species. **Birds:** Powerful Owl, Superb Lyrebird, Bassian Thrush. **Reptiles:** White's Skink.

f. Regionally restricted fauna (R5 species)

Regional. 91^a: 11 species. **Birds:** Painted Button-quail, Brush Cuckoo, Rose Robin, White-winged Chough. **Mammals:** Koala. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet. **Butterflies:** Spotted Skipper, Phigalia Skipper, Banks Brown**Local. 91^b:** 4 species. **Birds:** Brush Cuckoo, Red-browed Treecreeper. **Mammals:** Koala. **Reptiles:** McCoy's Skink

F. POPULATION DENSITY: Viability and Abundance–point census

k. Regionally endangered fauna (R1 species)

Regional. 91^a: 3 breeding pair of Peaceful Doves (Hedge Wattles)

m. Regionally rare fauna (R3 species)

Regional. 91^a: 10 breeding pair of White-browed Woodswallows on 27 October 1987

Outlook

Current management is maintaining faunal significance values.

FAUNA

Please note: the North and South Reference Areas (**91^C**) were not surveyed for fauna apart from incidental records.

Rare or Threatened Fauna

Bc **91^b: Powerful Owl.** One was heard calling in Mountain Grey Gum damp sclerophyll forest (4.1) while spotlighting near Humevale fire track, west of Coombs Road on 13 April 1988.

Bc **91^a: Brush-tailed Phascogale and Common Dunnart.** Both were recorded on 8 December 1991 in the reference stand Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) above Track 4, between Ridge Road and Humevale fire track. The phascogale was seen by spotlight in a Red Stringybark, some 400 m north of Ridge Road. The nest of a Common Dunnart was recorded nearby under a log earlier in the day. Both would also inhabit the extensive stands of Red Stringybark herb-rich foothill forest (6.1) also present.

Other Significant Fauna

Birds

Eb **91^b: Peaceful Dove and White-browed Woodswallow breeding in Hedge Wattles.** Three breeding pair of Peaceful Doves and 10 breeding pair of White-browed Woodswallows were recorded in Snow Gum grassy woodland (14.7) of the South Reference Area on 27 October 1987. Local irruptions into NEM from inland Australia occur for both species (see Yan Yean Reservoir and Plantations site).

Ec **91^b: Cicadabird and other damp mountain forest birds.** The Cicadabird was heard calling on 25 November 1988 from Messmate damp sclerophyll forest (4.2). A pair was located about 200 metres below the Humevale fire track, possibly breeding in the canopy of a tall Messmate. The Superb Lyrebird, Brush Cuckoo, Rose Robin and Bassian Thrush were also recorded in Messmate damp sclerophyll forest. Red-browed Treecreepers inhabit the Mountain Grey Gums (4.1).

Ec **91^a: White-throated Nightjar and other dry mountain forest birds.** A three hour bird survey was conducted on 8 December 1991 in the reference stand Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) above Track 4, between Ridge Road and Humevale fire track. Forty seven bird species were recorded. The bare, stony ground supports the White-throated Nightjar (likely breeding), Painted Button-quail (breeding) and Spotted Quail-thrush (likely breeding). The site provides the only extensive and secure breeding habitat remaining for the White-throated Nightjar and Spotted Quail-thrush in the Plenty Hills.

Mammals

Ed **91^b: Greater Glider and Eastern False Pipistrelle of the Coombs Road mountain forest.** Coombs Road/Humevale fire track at the north-east corner of the water catchment lies at 500 m elevation on the edge of the plateau of the Great Dividing Range. It forms the highest point in the upland hills and is the only area supporting true damp mountain forest. This includes Mountain Grey Gum damp sclerophyll forest (4.1) on the plateau, Messmate damp sclerophyll forest (4.2) on the upper sheltered mountain slopes and Broad-leaved Peppermint heathy forest (8.1) on the dry ridgetop.

Fourteen mountain species were recorded by the Humevale fire track on 12/13 April 1988. The Koala, Mountain Brushtail Possum and Greater Glider were spotted in the damp sclerophyll forest on 13 April 1988. The Gould's Long-eared Bat and Eastern False Pipistrelle were taken in a bat trap at a fire dam about 300 m west of the Coombs Road corner.

Reptiles

Ed 91^b: Coventry's Skink and Southern Grass Skink of the Coombs Road mountain forest. Eight reptile species were recorded in the section bordering the Humevale fire track, west of Coombs Road on 25 November 1988. Coventry's Skink was relatively common in the ridgetop Broad-leaved Peppermint heathy forest (8.1). This habitat also supported the White's Skink. The McCoy's Skink and Southern Grass Skink were located in Messmate damp sclerophyll forest (4.2) on the sheltered mountain slope.

Butterflies

91^a: Ridge Road to Humevale fire track. Twenty-seven breeding species were recorded. These include the Donnysa Skipper, Spotted Skipper, Bright Shield Skipper, Phigalia Skipper, Phigalioides Skipper, Symmopus Skipper, Common Dusky Blue, Cyril's Brown, Banks Brown and Spotted Brown.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Strategic Habitat Link. Intact habitat links to the Running Creek Headwaters site, Scrubby Creek Headwaters site and Yan Yean Reservoir site.	
	<p>Grassy Woodland Ecological Reference Area. The Scientific Reference Areas (MMBW 1984) contain extensive and relatively undisturbed stands of Yellow Box–Candlebark and Snow Gum–Yarra Gum grassy woodland. Snow Gum grassy woodland is not represented in an ERA elsewhere in NEM. The proposed Ecological Reference Area occurs in the closed section of the catchment south of Ridge Road. This encompasses both MMBW Scientific Reference Areas.</p> <p>Yan Yean Reference Areas Management Plan. Management is outlined in the plan (MMBW 1984). In summary, the main issues are water management, alien plant species, access and adjoining roads, fire protection (grazing by kangaroos has kept the fuel load down to a minimum), buffer areas and research guidelines. Altering the management of most issues may affect the conditions needed for the survival of native species or alter the conditions to favour alien species.</p> <p>Increase management works and maintain low public access rates. Increased management works and retained low rates of public access are essential to the long-term viability of the system.</p>
Other Issues	

Kangaroo grazing. The reservoir enclosure supports substantial populations of Eastern Grey Kangaroos and Black Wallabies. Severe browsing of shrublands (by the wallabies and Brown Hares) and grazing of the grassy woodland and semi-aquatic herbfields (by the kangaroos) is evident. Shrubs have been eliminated from the grassy woodland. Grazing-sensitive herbs such as Clover Glycine and orchids show the effects of heavy grazing pressure from the kangaroos.

Confinement inside a 2 m high wire mesh fence has led to severe overstocking (MMBW 1984). Culling operations were conducted in the early 1960s by the (then) Fisheries and Wildlife Department. In cold, wet winters the kangaroo population is naturally culled by high juvenile mortality rates, attributed to starvation (Keith Dempster pers. comm.). There is evidence that long-term selective grazing (of the more palatable species such as the herbaceous legumes) has led to a decline in the carrying capacity of the reserve for macropods.

Eucalyptus dieback. Insect defoliation is causing dieback of Swamp Gums, River Red Gums and Yarra Gums and their understorey wattles. This is related to the depletion of shrub cover (such as Black Wattle) for insectivorous birds by the herbivore grazing.

Future kangaroo culling and exclusion plots. Stock grazing in the catchment was excluded prior to the flooding of the reservoir in 1857. The area had been partially cleared. Much of the woodland and forest vegetation present in the catchment to the north-east of the reservoir has since regenerated. The impact of kangaroo grazing on field layer and shrubland vegetation should be monitored. The kangaroo population should be managed so that floristic diversity is not depleted and the vigour of native vegetation is not adversely affected (Scarlett 1983).

The vegetation would substantially recover under reduced grazing pressure from Eastern Grey Kangaroos. Future culling operations seem necessary to alleviate the damage incurred to the rare plant/habitats present. Kangaroo exclusion plots should be established and monitored. Floristic studies could then assess the grazing effect. This may provide vital information if a rational culling plan is to be devised. Management needs to consider the installation of kangaroo gates in strategic sections of the fence.

Trial burning program to maintain floristic diversity. The natural woodland system was formerly exposed to sporadic burning. Hot season fires were set by lightning. Cooler season fires were set by the Aborigines. Many species present (e.g. Tree Banksia, shrub peas and wattles) have declined due to the combined effects of lack of fire and heavy grazing pressure from kangaroos. A trial burn program to promote natural regeneration containing unburnt and burnt plots should be established. An alternating system of cool late spring and hot early autumn strip burns should be employed. A cyclic fire management program of differing treatment cycles should be instigated. The trials might include long-term unburnt, three-year burns and six-year burns—different intervals between fire episodes will favour the regeneration of different plant species.

Monoculture plantations favour leaf insects and not foliage birds. A contributing factor to the dieback of the native eucalypts is the hosting of foliage insects by the plantation eucalypts. The insect populations are high due to the proximity of monoculture plantations of species such as Sugar Gum and Bangalay, which are favoured by the Gum-leaf Skeletoniser. These areas contain few shrubs and important avian predators of leaf caterpillars such as Olive-backed Orioles, Buff-rumped Thornbills and whistlers and their host cuckoos are uncommon. The lack of shrubs and abundance of edges created by the plantations and the management tracks and surrounding roads suits the Noisy Miner. The large numbers present drive away the smaller foliage insectivores

Weeds. The most prevalent weeds in low sections of the catchment are alien grasses such as Sweet Vernal-grass and Yorkshire Fog. There are localised occurrences of Blackberry, Bulbil Watsonia and Spanish Heath. Sugar Gum and Monterey Pine (these two species by far the worst) and Bangalay, Tasmanian Blue Gum, Cootamundra Wattle and Black Cypress Pine invade the bushland areas from the plantations.

Incongruous management along Ridge Road. Roadside verges contain some of the City of Whittlesea's rarest plant and animal species. The verge backing Yan Yean Reservoir along Ridge Road is considered the most significant. Sections near Deep Creek Road have been destroyed by grading. This procedure has led to outbreaks of environmental weeds such as Montpellier Broom and Flax-leaf Broom, whose seed is spread and germinated by earthworks. Grading replaces the native Kangaroo Grass with a sward of annual grasses which die off over summer and present a fire hazard (Kangaroo Grass remains relatively 'green' while actively growing over summer).

Require dieback and foliage insect/insectivorous bird studies. The cause and effect relationships of eucalyptus dieback at Yan Yean Reservoir should be investigated. This would include comparing the ability of affected and unaffected woodland stands to support populations of insectivorous birds and function as faunal corridors.

Weed control. Plantation escapees and other weeds including Sweet Briar and alien grasses require control. Occurrences of broom and Spanish Heath along Ridge Road and Yan Yean–Arthurs Creek Road need monitoring and control.

Roadside grassland management in the City of Whittlesea. In the context of roadside verge vegetation in NEM, stands along Ridge Road are highly significant. The verge adjoins and is part of an important site of biological significance. It contains several rare species including the Yarra Gum and Clover Glycine and regionally significant grassy woodland vegetation including Snow Gum, Candlebark, native grassland orchids (about 20 species) and regionally threatened plants such as the Narrow-leaf New Holland Daisy.

Areas inside the reservation fence are heavily slashed, presumably for fire protection purposes. Grazing land adjoins on one side and a cleared 30 m strip heavily grazed by Eastern Grey Kangaroos buffers the reservoir on the other.

The City of Whittlesea must review unnecessary destruction of significant native grassland vegetation along roadsides. Intact stands of wildflowers along roadsides are far more desirable from a conservation and aesthetic standpoint than swards of introduced weeds or bared batters. A review of earthwork procedures and a survey of roadsides for native plants and invertebrates and weeds is required in the City of Whittlesea. Significant areas must be mapped and accordingly protected (e.g. weed control).

Planning Recommendations

Grassy Woodland Ecological Reference Area. The closed catchment to the east and north-east of Yan Yean Reservoir forms the proposed Grassy Woodland Ecological Reference Area (see Regional Habitat Link Strategy). A buffer zone is provided by surrounding Melbourne Water land.

Designated threatened or depleted landform, habitat, assemblage or species categories in the ERA include:

- Yellow Box–Red Stringybark box–stringybark woodland: small stands amongst the plantations to the east of the reservoir and larger areas backing Ridge Road to the north (few others occurring on public land in NEM); rare tree form of Silver Banksia.
- Yellow Box–Candlebark grassy woodland: most intact/extensive stand on public land in NEM.
- Snow Gum–Yarra Gum grassy woodland: most intact/extensive stand in NEM; disjunct/biogeographically significant habitat, rare orchid assemblages and Clover Glycine.

Supportive habitats: Messmate–Narrow-leaf Peppermint gully woodland along Dry Creek and Swamp Gum gully woodland on drainage line flats.

Site 92 Yan Yean Reservoir and Plantations

- Map Reference:** 7922 355417 (mid-point of Yan Yean Reservoir). One minute lat/long grids include 37° 31' x 145° 08', 37° 32' x 145° 08', 37° 33' x 145° 07' to 145° 09' and 37° 34' x 145° 07' to 145° 08'.
- Location/Size:** Approximately 1300 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: water storage reservoir and catchment (Melbourne Water).
- Landforms:** Foothill (see PUH B). Elevation is 180–260 m.

Natural Heritage Values

Landscape. The eucalyptus arboretum on the east inlets of the reservoir contains stands of Red Ironbark, Spotted Gum, Blakely's Red Gum, Tasmanian Blue Gum and Silvertop. These form the most important section for nectar-feeding birds at the reservoir. The plantations and arboretum were laid out by F. von Mueller. Bears Castle, which is one of the oldest 'cob structures' in Australia (Wuchatsch & Hawke 1988), has historical significance.

Scientific and Educational Values

Invertebrates. A species of freshwater jellyfish (*Craspedacusta sowerbyi*) is present in the reservoir (Bruce Saunders pers. comm.). The known range is disjunct and its next nearest known occurrence are the Coorong in the south-east of South Australia, far East Gippsland and Canberra. Waterbirds (e.g. pelicans) appear to have provided the long distance dispersal of the planktonic stages. The species was first recorded in Australia in 1950

HABITAT SIGNIFICANCE:

Assessment: Very High–Category 2

Reference stands: Rush Sedge–Common Spike-sedge seasonal wetland (25.1; northern arm of the reservoir at Castle Flat)

Relatively intact and extensive stands: Common Reed–Cumbungi permanent wetland (25.7); Blunt Pondweed–Lake Eel-grass permanent wetland (26.1)

Partially intact or small stands: Yellow Box–Red Stringybark box–stringybark woodland (11.2; eastern lookout and picnic area)

Endangered species: Basalt Plain Leek-orchid, Large-fruit Groundsel (both at Castle Flat)

Vulnerable species: *Hypsela* (Castle Flat; only known population in GM)

Rare/depleted species: Swamp Billy-buttons (Castle Flat)

Critical assemblages or populations: seasonal wetland at Castle Flat and its regionally endangered semi-aquatic flora. This includes the above VROT species and the Narrow-leaf Nardoo (only known population in GM) and Slender Mint

Notable features: the plantations which occupy about 25% of the management unit were established in the late nineteenth century, some time after the reservoir was commissioned. The dominant plantation species include Sugar Gum, Tasmanian Blue Gum, Red Ironbark, Spotted Gum, Bangalay, Monterey Pine and Black Cypress Pine. The swamp where the reservoir stands would have formerly been fringed by River Red Gum grassy woodland (14.3) with low-lying areas supporting Swamp Paperbark swamp scrub (17.1) and Swamp Gum swampy woodland as occur to the west in the Plenty River Yan Yean unit. Shallow freshwater marsh and freshwater meadow vegetation (seasonal wetland habitats 25.1 and 25.7) which now fringe the reservoir would have been extensive.

FAUNAL SIGNIFICANCE: Site 92 Yan Yean Reservoir and Plantations

Assessment: State–Category 1 (B, C, D, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

92^a: 37° 32' x 145° 08'; Yan Yean Reservoir–north-east sector/Castle Flat

92^b: 37° 33' x 145° 07'; Yan Yean Reservoir–south-west sector

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 92^a: Regent Honeyeater; 2 in flowering Red Ironbark and Tasmanian Blue Gum on 30 August 1990

b. Vulnerable fauna

State. 92^a: Swift Parrot; 10 in flowering Red Ironbark and Tasmanian Blue Gum on 30 August 1990 and 6 in flowering Sugar Gum on 23 February 1991

c. Rare fauna

Regional. 92^a: Blue-billed Duck, White-bellied Sea-eagle

Regional. 92^b: Large-footed Myotis

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

b. Waterbirds

State. 92^a: 32 species on 11 April 1988 **Regional:** 26 species on 25 August 1987.

h. Bats

Regional. 92^a: 4 species including the Gould's Long-eared Bat trapped on Track 9, 300 m west of Track 5 on 14 April 1988

m. Freshwater fish

Regional. 92^a: Short-finned Eel and Common Galaxias on 27 October 1987

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

State. 92^a: over 140 species

b. Native birds

State. 92^a: over 120 species

c. Native mammals

Regional. 92^a: 12 species

d. Herpetofauna

Regional. 92^a: 12 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

State. 92^a: 29 species

b. Regionally endangered fauna (R1 species)

State. 92^a: 4 species. **Birds:** Peaceful Dove, White-bellied Sea-eagle, Regent Honeyeater, Little Friarbird

c. Regionally vulnerable fauna (R2 species)

Regional. 92^a: 3 species. **Birds:** Brown Treecreeper, Yellow-tufted Honeyeater, Fuscous Honeyeater

Regional. 92^b: 1 species. **Mammals:** Large-footed Myotis

d. Regionally rare fauna (R3 species)

State. 92^a: 13 species. **Birds:** Great Crested Grebe, Darter, Caspian Tern, Hardhead, Blue-billed Duck, Australasian Shoveler, Pink-eared Duck, Musk Duck, Collared Sparrowhawk, Little Corella, Spotted Quail-thrush. **Mammals:** Gould's Long-eared Bat. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

Regional. 92^a: 9 species. **Birds:** Latham's Snipe, Swamp Harrier, Whistling Kite, Peregrine Falcon, Swift Parrot, White-winged Triller, Bassian Thrush, Speckled Warbler. **Reptiles:** Red-bellied Black Snake

f. Regionally restricted fauna (R5 species)

Regional. 92^a: 19 species. **Birds:** Painted Button-quail, Brush Bronzewing, Pied Cormorant, Australian Pelican, Nankeen Night Heron, Royal Spoonbill, Great Egret, Cattle Egret, Australian Shelduck, Rainbow Lorikeet, Purple-crowned Lorikeet, Little Lorikeet, Long-billed Corella, Brush Cuckoo, Olive Whistler, Red-browed Treecreeper, Spiny-cheeked Honeyeater, White-winged Chough. **Reptiles:** Bougainville's Skink

g. Nesting birds of prey

Regional. 92^a: Whistling Kite in a Sugar Gum stick-nest. Likely: Collared Sparrowhawk and Peregrine Falcon

F. POPULATION DENSITY: Viability and Abundance–point census

a. Migratory birds

Regional. 92^a: 12 Latham's Snipe at Castle Flat on 20 October 1987

b. Rare fauna

Regional. 92^a: 10 Blue-billed Ducks on 25 August 1987

c. Waterfowl

State. 92^a: nocturnal congregations in autumn-winter of over 1000 waterfowl (up to 50% are local district Australian Wood Ducks) and several thousand in droughts. Day counts in north-east sector: 235 of 13 species on 25 August 1987 and 287 of 14 species on 11 April 1988. Over 500 birds at reservoir on both occasions

g. Rare/restricted colonial fauna

State. 92^a: nocturnal roost of over 1000 Straw-necked Ibis in the north-eastern plantation on 11 April 1988.

Regional. 92^b: two Large-footed Myotis in the Toorourrong–Yan Yean inlet tunnel on 6 April 1992

m. Regionally rare fauna (R3 species)

Regional. 92^a: 6 Great Crested Grebe, 20 Hardhead, 8 Australasian Shoveler and 10 Blue-billed Duck on 25 August 1987 and 20 Musk Duck on 11 April 1988; 10 Little Corellas roosting in the north-eastern plantation on 25 August 1987

o. Regionally restricted fauna

Regional. 92^a: 20 Long-billed Corellas on 25 August 1987 and 30 Cattle Egrets on 27 October 1987, roosting in the north-eastern plantation

Outlook

Current management is maintaining faunal significance.

FAUNA

Rare or Threatened Fauna

Ba **92^a: Regent Honeyeater in the flowering plantation trees.** On 30 August 1990, two were observed feeding in flowering Tasmanian Blue Gums and Red Ironbarks in the north-eastern plantation fringing the reservoir.

Bb **92^a: Swift Parrot in the flowering plantation trees.** On 30 August 1990, 10 were observed feeding in flowering Tasmanian Blue Gums and Red Ironbarks in the north-eastern plantation. Six were again observed in flowering Sugar Gums on 23 February 1991. Prolific flowering plantation eucalypts (notably Tasmanian Blue Gum and Red Ironbark and in some years, Sugar Gum) and a year-round nectar supply attract substantial populations and diversity of nectar and pollen feeding birds. Four species of lorikeets (notably the Little, Purple-crowned and Rainbow), the Swift Parrot and 16 species of honeyeaters (notably the Regent, Fuscous, Yellow-tufted and Spiny-cheeked) and the Little Friarbird have been recorded.

Bc **92^a: White-bellied Sea-eagle.** An individual first appeared in 1986 as an immature and was observed on most visits to the eastern section of the reservoir between 1987 and 1991 (25 August 1987, 11 April 1988, 30 August 1990 and 23 February 1991). This was joined by a second adult bird in 1988. The birds at Yan Yean had a favoured perch in a Sugar Gum by the water's edge on the eastern arm of the reservoir. This was used for resting as well as a prey vantage. They were often seen soaring high over the water on their large upswept wings.

Juveniles and some adults disperse widely away from coastal nesting localities to inland waterbodies during late autumn–winter (Emison *et al.* 1987). The nearest nesting localities are at Western Port, the Gippsland Lakes (half the known sites are on private land) and the Murray Valley (Emison *et al.* 1987). They build a huge stick-nest, added to over many years, in a large branch-fork or at the junction of the trunk and two radiating branches of a tall eucalypt near water.

The sea-eagles were observed coursing over the reservoir, descending to snatch fish (probably Redfin) from just beneath the water's surface. They also take waterfowl at rest on the surface, carrion (e.g. poisoned or viral-infected rabbits) and tortoises (Blakers *et al.* 1984, Readers Digest 1986). They infrequently take live mammals such as rabbits.

The species has declined due to clearing of coastal forests and nest-site disturbance associated with coastal development. Last century they were common on Western Port and Port Phillip (Wheelwright 1862), but are now reduced to a single pair on French Island. In the past, the sea-eagle was shot, poisoned (sometimes indirectly by baited carcasses left for dogs and foxes) or caught in dog traps set by graziers. They are not considered to be a significant predator of lambs as they infrequently take live prey from land, but they have been blamed, because they feed on carrion (e.g. still-born lambs or those attacked by ravens).

White-bellied Sea-eagles occasionally breed at inland waterbodies (e.g. Lake Hume). Given the solitude and food provided by Yan Yean Reservoir, breeding may occur in the future. This may provide a backup to failing coastal breeding sites due to increasing pressure from humans. Disturbance on the eastern side of Yan Yean Reservoir must be kept to a minimum if breeding is to occur.

Bc **92^a: Blue-billed Duck.** Yan Yean is important for this rare waterfowl. Ten were present in the north-eastern sector on 25 August 1987. Blue-billed Ducks are present year-round in fluctuating numbers on the larger waterbodies of NEM. There are normally 5–10 birds on Yan Yean Reservoir and the Plenty Gorge quarry wetlands (see site 40 for further discussion on breeding). Single birds or pairs are occasionally seen on dams.

Numbers on Yan Yean Reservoir fluctuate seasonally showing a late autumn–winter influx (normally about 20), presumably of local birds coming to moult. These break up into smaller flocks and pairs on the onset of spring rains and disperse to the quarry wetlands and swamps of the district for breeding. During

inland droughts (e.g. summer–autumn 1977/78 and 1982/83), 100 or more appear on Yan Yean and smaller numbers elsewhere in NEM, indicating an exodus towards the coast away from the Murray Valley.

Blue-billed Ducks are mostly recorded in NEM on deep, open water of reservoirs and quarry wetlands on the plains. These usually support emergent and submerged herbfields. As well as gathering benthic (bottom dwelling) insect larvae (e.g. midges and stoneflies) from deep dives, they upend and dabble in shallow water, stripping shoots and seeds from aquatic plants (Blakers *et al.* 1984). They feed on the fruits of Blunt and Fennel Pondweed at the O’Herns Road Quarry and Morang Wetlands of the Plenty Gorge, often in association with Eurasian Coots.

- Bc* **92^b: Large-footed Myotis in the Toorourrong–Yan Yean Aqueduct inlet tunnel.** The aqueduct enters Yan Yean Reservoir via a bluestone tunnel. The high water level in the tunnel is about 1.2 m, leaving an air space over the water of about 1.3 m. On 13 February 1989 a bat trap was placed over an access track about 20 m from the tunnel entrance. One Large-footed Myotis was caught. Two were seen leaving the tunnel entrance during a dusk watch in April 1992. One was later seen coursing over the aqueduct. The myotis pass through a 15 cm gap between the floodgates and the bluestone entrance of the tunnel. They appear to roost just inside the tunnel behind a timber beam across the top of the floodgates. No Common Bent-wing Bats were seen in the tunnel on an inspection in June 1992. This species would roost in hanging clusters from the ceiling. None had been seen there previously (Ray Fletcher pers. comm.).

Critical Assemblages or Populations

- Cb* **92^a: High diversity of waterbirds.** The north-east sector supported 32 species on 11 April 1988 and 26 species on 25 August 1987. A list of over 40 species of waterbirds was compiled from all visits. This includes the regionally rare Darter and Caspian Tern (two present on 11 April 1988). The Pied Cormorant was also seen. The cormorant and tern are coastal species that are rare in NEM. A dozen Latham’s Snipe were flushed in October 1987 from the seasonal wetland and mudflats on Castle Flat (northern tip of reservoir).
- Fc* **92^a: High population density of waterfowl—largest population in NEM.** Day counts in the north-eastern sector of the reservoir contained 235 birds of 13 species on 25 August 1987 and 287 birds of 14 species on 11 April 1988. An estimated 500 plus birds were present at the reservoir on both occasions. At night during autumn and winter over 1000 waterfowl (the influx predominantly of Australian Wood Duck from the district), and several thousand exceptionally in droughts, congregate at the reservoir.

The deep, open water and vegetated shallows support species such as the Australasian Shoveler, Musk Duck, Pink-eared Duck and Blue-billed Duck. The diving ducks appeared to be feeding on the shoots of Lake Eel-grass, Blunt Pondweed and Small-fruited Water-mat in November 1987 and the ripened fruit of Small-fruited Water-mat in April 1988. The best areas for waterfowl are the submerged herbfields of the shallow northern and eastern arms. The numerically dominant species are Eurasian Coots and Australian Wood Ducks.

- Fg* **92^a: High population density of Straw-necked Ibis and a roosting sanctuary for other plains birds.** Over 1000 ibis roosted in the plantations adjacent to the eastern arms of the reservoir on 11 April 1988. From about a half hour before dusk onwards, birds came in flocks of 50 to several hundred from the surrounding plains. The ibis are highly ‘user friendly’ in that they feed on farmland pasture pests. The numbers occupying the plains depend on the sanctuary, the water and the roosting trees provided at Yan Yean.

Over 30 species of birds that feed in the plains by day come to roost at night at the reservoir. These include parrots such as the Little and Long-billed Corellas, lorikeets and Red-rumped Parrots, birds of prey such as the Black-shouldered Kite and ducks and other waterbirds including the Cattle Egret, Australian Pelican, spoonbills, ibis and herons. When the Straw-necked Ibis influxes into southern Victoria during autumn–winter, the largest nocturnal roost in NEM is in the Yan Yean plantations.

Other Significant Fauna

Birds

Eb **92^a: Peaceful Dove.** This species has become very rare in GM. Two pair were breeding in a small area of Yellow Box–Red Stringybark box–stringybark woodland (11.2) at the margin of a Black Cypress Pine plantation east of Castle Flat on 27 October 1987. The two nests located were platforms of sticks placed in a horizontal branch-fork, one in a Black Cypress Pine and the other in a Hedge Wattle.

The Peaceful Dove is characteristically a species of the semi-arid, open-country inland and tropical far north of Australia. Their range extends into GM through the Kilmore Gap of the Great Dividing Range. They are usually found near permanent water and their diet consists of seeds and grain taken from the ground. Small irruptions occur in spring–summer from northern Victoria during inland droughts; particularly 1982–83. A larger irruption occurred in spring 1975, a wet year in southern Victoria. Birds had dispersed after the big flood year of 1974 in the Murray Valley, which was a productive breeding season. They are an irregular visitor at other times.

Ec **92^a: Brown Treecreeper and the rare co-occurrence with two other species of treecreepers.** The Brown Treecreeper inhabits areas with a light tree cover, copses of tall shrubs and tussock grasslands. It has become very rare in NEM through the combined effects of woodland habitat loss on the plains and fox and cat predation. A small colony was located in a native stand of Yellow Box–Red Stringybark box–stringybark woodland (11.2), amongst the eastern plantations of the reservoir. Only about six sightings of the species were made in NEM. Like the Peaceful Dove, their persistence at Yan Yean is significant and the low disturbance and predator density and habitat provided by open plantations near the reservoir and the grassy woodlands in the reference area to the east would appear the best opportunity for survival of both species in NEM.

The reservoir plantations contain all three southern Victorian treecreeper species. The Red-browed Treecreeper is a mountain forest species adapted to dense stands of gum-barked eucalypts. A colony was observed in the Sugar Gum plantation near the eastern shore. The White-throated Treecreeper is a widespread forest species and is common in the plantations.

Ed **92^a: Great Crested Grebe.** Four were present on 25 August 1987. Their main fish prey at Yan Yean are young Redfin.

Ed **92^a: Australasian Shoveler, Pink-eared Duck, Hardhead and Musk Duck.** Eight shovelers were present in the north-eastern sector on 25 August 1987. Thirty or more shovelers have been seen in moult during summer–autumn. They take invertebrates by filter feeding in the deeper waters and trawling in the shallows. Four Pink-eared Ducks were present on 11 April 1988. Their feeding behaviour and diet is similar to the shoveler, but vegetable material is also taken. They visit deep open waterbodies and shallow freshwater marshes and meadows (after flooding rains), mainly as nomadic summer–autumn visitors from inland Australia. Fifty to 100 birds were observed on Yan Yean Reservoir in autumn 1983, after the 1982 drought.

Twenty Hardhead were present in the north-eastern sector on 25 August 1987. They are irregular summer–autumn visitors from inland Australia and are capable of moving long distances. Influxes occur during inland droughts, particularly the autumn of 1983. At this time over 100 were present on Yan Yean Reservoir. They are generalist feeders. Hardhead can dive for long periods and commonly occur in deep water, where they chase small fish and bottom feeders such as yabbies. They also graze underwater plants in the shallows.

Twenty Musk Ducks were present in the north-east sector on 11 April 1988. They visit deep, open waterbodies in NEM in late summer and autumn. Apart from Yan Yean and Toorourrong Reservoirs, where up to 10 resident pairs are present, they are usually seen as single immature birds. Their prey at Yan Yean is predominantly swimming and benthic insects and their larvae as well as larger prey items such as crustacea, mussels and frogs, taken while deep diving, or combing the silt in the shallow arms.

Mammals

Ed 92^a: Gould's Long-eared Bat. One was trapped in mid-April 1988 beneath flowering Sugar Gums adjacent to the reservoir. It was possibly attracted by the large numbers of insects present. This upland species has been infrequently trapped below 200 m elevation in GM. Most low altitude records have been from late summer–autumn, indicating the species may undertake altitudinal movements, similar to mountain insectivorous birds. The Sugar Glider, which is common in the old plantation trees, also feeds on nectar and pollen-seeking insects at flowering time.

Freshwater fish

Ed 92^a: Common Galaxias at Yan Yean Reservoir. They are present in the reservoir and the Toorourrong–Yan Yean Aqueduct. The two main species in the reservoir are the Redfin and Short-finned Eel (Bruce Saunders pers. comm.). Brown Trout have been liberated but appear not to breed as the running water inlet streams are too ephemeral. They reintroduce into the reservoir over the spillway of the Toorourrong–Yan Yean Aqueduct.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link. Intact habitat links to the Scrubby Creek Headwaters site, Ridge Road -Sherwin Range Catchment–Reference Area site, Dunnetts Road Swamp–Plenty River Cades Road site and Mernda to Yan Yean site.</p>	
	<p>Strengthen habitat links. Habitat links to the west, south and east need to be reinforced. The area to the south is proposed for residential development. Faunal corridors through this area must be provided by replanting River Red Gums and Yellow Box links and establishing effective shrub layers of wattles and Drooping Sheoke. To the west are small farms and some rural residential areas in the Plenty River floodplain. This area will undergo further development.</p>
Regional Hydrological Strategy	
<p>Land and habitat degradation has been severe on broad-acre farmland on the upper reaches of the Stewart Ponds Creek and Running Creek to the east of the reservoir.</p>	<p>Instigate the Plenty River Stream and Floodway Zone along Dunnetts Road. This was proposed for the Plenty Corridor (MPE 1990). A streamway conservation management plan is vital (see Plenty River Yan Yean unit). This area requires special conservation management given the biological significance and degree of soil erosion, salination and stream siltation occurring.</p>
Others Issues	
<p>Future public access to Yan Yean. The reservoir provides less than 5% of Melbourne’s water storage. Because it is so close to the Plenty Corridor, demand for public usage of the reservoir (at least for passive water sports) might increase if it were considered no longer essential to Melbourne’s water supply system. Opening the reservoir to the public would be highly disadvantageous to the waterfowl and other faunal values.</p>	<p>Retain closed access to public. The eastern and northern arms of the reservoir are closed to public access and as such are important for waterfowl and the White-bellied Sea-Eagle. Given its faunal significance, access to the water and the eastern and northern sides of the reservoir should necessarily remain closed to the public.</p>

Effect of raising top water level and flooding grassy woodlands. The top water level of the reservoir may be raised at some time in the future (MMBW 1984). This could flood the remnant River Red Gums at the edge of the reservoir and some of the flats containing Snow Gum and Yarra Gum to the east of the reservoir. Flooded trees might die and at least short-term loss would occur in the shallows of submerged and emergent herbfields important for waterfowl conservation. The extensive shallows of Yan Yean are the main reason it supports large populations of waterbirds.

Management of the waterbody area should remain unchanged with regard to maintenance of conservation values.

PUH C UPPER PLENTY–EDEN PARK

This management unit consists of two sites of regional faunal significance (sites 93 and 94) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7923 309521 to 7923 300572 (north branch of the Bruces Creek); 7923 293530 to 7923 269506 (south branch of the Bruces Creek); 7922 267454 to 7922 266493 (Barber Creek).

Location/Size: Approximately 6000 ha.

Municipality: City of Whittlesea and Shire of Mitchell.

Physical Features

The unit is a southern spur of the Great Dividing Range in the upland hills of the Eastern Uplands. It forms the point of convergence between the Western and Eastern Uplands, the Merri and Plenty Volcanic Plains and Plenty Upland Alluvial Plains. It contains the headwaters of Barber Creek and the south branch of Bruces Creek.

Landforms

Mountain: ridges, slopes, gullies, valleys and creek headwaters. Foothill: hill-crests, hill-slopes, gullies, valleys, flats, creeks and dams. Elevation is 220–407 m (Cleve Hill).

Hydrology

The west branch of the Bruces Creek rises on Cleve Hill in damp forest on sheltered mountain slopes of the Great Divide. On reaching cleared farmland it is a near-perennial stream of running riffles and cobbles and shallow sandy pools. The south branch drains the northern hill-slopes of the Eden Hills. It is ephemeral and contains dry sandy sections interspersed with small pools. The upper Barber Creek drains the southern slopes of Eden Hills and is similar in character to the south branch of Bruces Creek, though in lower rainfall and more cleared and degraded.

Rainfall: 650–850 mm.

Site 93 Eden Hills

Map Reference:	7923 275495 (mid-point); 7923 286513 (Denkert's bushland); 7923 275480 (McNair Estate). One minute lat/long grids include 37° 27' x 145° 03' to 145° 04', 37° 28' x 145° 02' to 145° 04', 37° 29' x 145° 02' to 145° 04', 37° 30' x 145° 02' to 145° 03' and 37° 31' x 145° 03'.
Location/Size:	Hills west and north of Eden Park. Approximately 1200 ha.
Municipality:	City of Whittlesea.
Land Tenure/Use:	Public: the McNair Estate (formerly Melrose Park) is south of Glenburnie Road near Janna Road and has been bequeathed to the Crown for conservation purposes; small sections of road reserves. Private: larger estates (e.g. Denkert's) now broken up into 8 and 40 ha properties. Formerly cattle and sheep farms and some orchards. Now becoming small mixed farmlets, bushblocks and large residential blocks.
Landforms:	Ridges, hill-crests, hill-slopes, valleys, gullies, creeks and dams. Elevation is 240–352 m.

Natural Heritage Values

Landscape. Gently undulating foothills of the Great Dividing Range with geological affinity with northern and western Victoria (e.g. Lancefield). The landscape is heavily cleared throughout Victoria. The site supports very old and large trees (e.g. Candlebark and Yellow Box) on farmland. Sandstone/duplex soils in low rainfall areas (influenced by the Kilmore Gap) when cleared are subject to heavy erosion. The area serves to illustrate the harsh effects of unsustainable land-use (e.g. excessive land clearing) on this landscape. Of historic significance are the ruins of the old Cobb and Co. staging station on Denkert's (west of Towts Road, now subdivided into farmlets).

HABITAT SIGNIFICANCE

Assessment: Medium–Category 1

Relatively intact and extensive stands: Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark valley forest (31.1)

Partially intact or small stands: Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Swamp Gum gully woodland (10.3); Yellow Box–Red Stringybark box–stringybark woodland (11.2)

Rare species: Yarra Gum

Notable features: diverse orchid assemblage on the McNair Estate. There were extensive stands of Yellow Box–Candlebark valley forest on Denkert's bushland prior to sub-division in 1989, when the block of about 200 ha underwent 40 ha farmlet subdivision. Prior to this, the low stocking rate had enabled extensive regeneration of the shrub and ground flora. It is likely (but unknown) that more intensive grazing levels and possibly clearing has occurred since that time. The habitat quality is likely to have declined. The presence of scattered White Box, Grey Box and Silver Bundy on the semi-cleared exposed slopes near the west branch of the Barber Creek (near Grants Road) is indicative of a biogeographical link with north-eastern Victoria. The Shiny Everlasting and Peach Heath (present in Yellow Box–Red Stringybark box–stringybark woodland) are indicative of a biogeographical link with box–ironbark woodland of northern Victoria.

FAUNAL SIGNIFICANCE: Site 93 Eden Hills

Assessment: Regional–Category 1 (B, C, D, E, F)

Reference grids for the significance keys include:

93^a: 37° 28' x 145° 03'; Denkert's bushland, Upper Plenty

93^b: 37° 29' x 145° 02'; McNair Estate/Glenburnie Road, Eden Park

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 93^a: Brush-tailed Phascogale

Regional. 93^b: Common Dunnart

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

f. Breeding migratory insectivores

Regional. 93^b: 9 species including the Sacred Kingfisher, Rainbow Bee-eater and Tree Martin at McNair Estate on 14 November 1989

Regional. 93^a: 8 species including the Sacred Kingfisher, Brush Cuckoo, Rainbow Bee-eater, Leaden Flycatcher and White-throated Gerygone at Denkert's from 6 to 9 November 1988

h. Bats

Regional. 93^a: 5 species including the Chocolate Wattled Bat and Large Forest Bat trapped at Denkert's from 6 to 9 November 1988

k. Frogs

Regional. 93^a: 6 species including the Victorian Smooth Froglet and Bibron's Toadlet at Denkert's on 11 October 1988; 6 species including the Common Spadefoot Toad and Plains Froglet at Denkert's from 6 to 9 November 1988

l. Reptiles

Regional. 93^a: 11 species including the Tree Dragon, Common and Blotched Blue-tongued Lizards, White's Skink, McCoy's Skink, Weasel Skink, Eastern Three-lined Skink, Southern Water Skink and Eastern Brown Snake taken from a pitfall trapline set at Denkert's from 4 to 9 November 1988

D. REPRESENTATIVENESS: Faunal Assemblages–reference grid survey

a. All native vertebrate fauna

Regional. 93^a: Over 100 species. **Regional. 93^b:** 109 species

b. Native birds

Regional. 93^b: 93 species. **Regional. 93^a:** over 60 species

c. Native mammals

Regional. 93^a: 11 species. **Regional. 93^b:** 7 species

d. Herpetofauna

Regional. 93^a: 24 species. **Regional. 93^b:** 9 species

E. REPRESENTATIVENESS: Significant Species–reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 93^b: 15 species. **Local. 93^a:** 12 species

c. Regionally vulnerable fauna (R2 species)

Regional. 93^a: 5 species. **Birds:** White-throated Nightjar, Black-eared Cuckoo, Brown Treecreeper, White-throated Gerygone. **Mammals:** Brush-tailed Phascogale

Regional. 93^b: 4 species. **Birds:** Black-eared Cuckoo, Brown Treecreeper, White-throated Gerygone. **Mammals:** Common Dunnart

d. Regionally rare fauna (R3 species)

Regional. 93^b: 3 species. **Birds:** Masked Woodswallow, White-browed Woodswallow. **Frogs:** Plains Froglet

Regional. 93^a: 1 species. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 93^b: 8 species. **Birds:** Swamp Harrier, Peregrine Falcon, Rainbow Bee-eater, Leaden Flycatcher, Speckled Warbler, White-winged Triller, Bassian Thrush and Rufous Songlark

Regional. 93^a: 6 species. **Birds:** Rainbow Bee-eater, Leaden Flycatcher, Speckled Warbler, Rufous Songlark. **Reptiles:** White's Skink. **Frogs:** Bibron's Toadlet

f. Regionally restricted fauna (R5 species)

Regional. 93^a: 8 species. **Birds:** Painted Button-quail, Brush Cuckoo, White-winged Chough. **Reptiles:** Delicate Skink, Bougainville's Skink, McCoy's Skink. **Frogs:** Striped Marsh Frog, Common Spadefoot Toad

Local. 93^b: 4 species. **Birds:** Australian Pelican, Long-billed Corella, White-winged Chough. **Reptiles:** Bougainville's Skink

g. Nesting birds of prey

Regional. 93^a: Wedge-tailed Eagle; active stick nest in a large Yellow Box at Denkert's in October 1988

F. POPULATION DENSITY: Viability and Abundance-point census

l. Regionally vulnerable fauna (R2 species)

Regional. 93^a: 7 Brown Treecreepers in two breeding colonies at Denkert's on 11 October 1988

n. Regionally depleted fauna (R4 species)

Regional. 93^{ab}: 12–15 Rainbow Bee-eaters in breeding colonies in the banks of gullies at Denkert's on 6 November 1988 and McNair's on 14 November 1989

Outlook

Bushblock subdivision, increased stocking levels and clearing since 1988 has led to a decline in flora (particularly orchids) and faunal values. A period of low intensity land-use over the previous 10 to 20 years had allowed substantial revegetation and land-healing from earlier clearing and soil erosion resulting from sheep grazing and timber harvesting.

FAUNA

Please note: intensive reptile and mammal trapping was conducted at Denkert's but time constraints prevented the same for McNair's. Faunal values and diversity of the two areas would be comparable. The bird diversity shown for McNair's is from a comprehensive list provided by a local ornithologist. A combination of fauna data from both areas is a true indication of the diversity of the site.

Rare or Threatened Fauna

- Bc* **93^a: Brush-tailed Phascogale.** A dead male phascogale was found at Denkert's in June 1988. The property contains extensive stands of Long-leaf Box–Red Stringybark box–stringybark woodland (11.4), a preferred habitat of the phascogale in NEM. This species is also likely to occur on the McNair Estate as the old box and stringybarks on the ridge support extensive tree hollows.
- Bc* **93^b: Common Dunnart on McNair Estate.** A female dunnart with four pouched young was located in a nest under a large flat rock at the McNair Estate on 14 November 1989. This property contains extensive stands of Long-leaf Box–Red Stringybark box–stringybark woodland (11.4), a preferred habitat of the dunnart in NEM. This species is also likely to occur on Denkert's bushland.

Other Significant Fauna

Birds

- Ec* **93^{ab}: Brown Treecreeper, White-throated Gerygone, Black-eared Cuckoo.** Each species inhabits the valleys supporting Yellow Box–Candlebark valley forest (31.1) at Denkert's and the McNair Estate. Seven Brown Treecreepers in two breeding colonies were observed at Denkert's on 11 October 1988. The treecreeper has become rare through the effects of land clearing and habitat fragmentation. This was the largest concentration of the species seen in the survey of NEM. Eden Hills and Yan Yean Reservoir appear the most important areas for the treecreeper in NEM. Two pair of White-throated Gerygones were present at Denkert's on visits between 11 October and 9 November 1988. Each nested in the canopy of Yellow Box. There were fewer than 10 observations of the spring migratory Black-eared Cuckoo during the NEM survey. Two of these were Denkert's (6 November 1988) and McNair's (24 October 1988).
- Ec* **93^a: White-throated Nightjar.** The White-throated Nightjar was heard calling from a ridge on the evening of 7 November 1988 at Denkert's. The ridge vegetation was composed of Long-leaf Box–Red Stringybark box–stringybark woodland (11.4). The nightjar is now threatened in the hills of NEM.
- Ee* **93^{ab}: Rainbow Bee-eater.** Three colonies of Rainbow Bee-eaters (each of 4-5 birds) bred in the banks of a dry creek in Denkert's bush in 1988. They commenced nest renovations on 11 October and were in constant nest attendance (probably commenced egg incubation) on 6 November. A similar number were recorded on 14 November 1989, breeding in the banks of the north-eastern gully fronting Glenburnie Road on the McNair Estate. The habitat at both locations was Swamp Gum gully woodland (10.3). Nest entrances were located in the vertical creek banks about 10 cm below the top of the bank. These occasionally had back entrances on the horizontal surface above the bank.

Over the last five years there has been a decline in the number of bee-eaters visiting the district. This could be linked to long-term effects of pesticides reducing the availability of insect prey. A proportion of their diet is adult flying insects which have aquatic larval stages (e.g. dragonflies). Clearing of native riparian vegetation, increased levels of water turbidity and pollution and lack of water flow over summer due to damming have probably reduced or eliminated much of the native food. The elimination of the Platypus from the Bruces Creek in the last few decades can probably be attributed to the same causes.

- Ee* **93^{ab}: Speckled Warbler.** The ridges and exposed hill-slopes of Denkert's and the McNair Estate contain a diverse assemblage of restricted shrub layer birds. One of these is the Speckled Warbler, which was observed in Long-leaf Box–Red stringybark box–stringybark woodland (11.4) at both localities. This species prefers thickets of wattles.

93^b: Diverse migratory insectivore assemblage at McNair's. Areas of Swamp Gum gully woodland (10.3) and Yellow Box–Candlebark valley forest (31.1) contained a number of migratory bird species. These included the Rufous Songlark, Masked and White-browed Woodswallows, White-throated Gerygone, Black-eared Cuckoo, White-winged Triller, Rainbow Bee-eater and Leaden Flycatcher. Each of these species is more common in the north (particularly north-east) of the state than the south. The

relatively high frequencies of observation is some evidence of the biogeographic link with northern Victoria.

93^a: Damp forest birds of Denkert's. The Messmate herb-rich foothill forest (6.3) on the sheltered hill-slopes contained the Brush Cuckoo, Crescent Honeyeater and Rufous Fantail.

93^b: Bird list for 'Bunke Bonnie'. The property is at the corner of Janna and Glenburnie Roads. A list of 86 native species was provided by P. and J. White (former owners) and Bill Smith (former owner). Species only recorded on their list for the site included the Swamp Harrier, Peregrine Falcon, Bassian Thrush and Black Honeyeater. The Black Honeyeater is a rare vagrant to GM from the inland. It was seen during the late spring of 1984. This coincided with a major influx of the species into Victoria after the 1982–83 drought (see Emison *et al.* 1987).

Reptiles and frogs

93^a: Diverse assemblage at Denkert's. An intensive survey including pitfalling was conducted. Twenty-four species were recorded. The Tree Dragon, Delicate Skink, Eastern Three-lined Skink and Plains Froglet were common. The McCoy's Skink and Victorian Smooth Froglet were present on the sheltered hill-slopes under Messmate herb-rich foothill forest (10.3). The Common Spadefoot Toad, Delicate Skink and White's Skink were trapped in a pitfall line. This was in dense Kangaroo Grass under Swamp Gum gully woodland in the headwaters of a dry creek running through Denkert's to the Bruces Creek. A geographical overlap occurs locally between the Bibron's and Southern Toadlet. Most toadlets encountered were hybrids, but were put down as Bibron's Toadlet. Both species of blue-tongued lizards were present.

93^b: Reptiles on the McNair Estate. Brief visits to the property, which lies south of Glenburnie Road, were made in 1988. Many of the bird species recorded on Bunke Bonnie were seen. The McNair Estate bushland has comparable habitat and faunal values to Denkert's bush (e.g. breeding colonies of bee-eaters). Bougainville's Skinks were common under small stones on the sandstone and shale hill-crests in Long-leaf Box–Red stringybark box–stringybark woodland (11.4) at McNair Estate. The Eastern Three-lined Skink, which is sparsely though widely distributed in NEM, was the most common skink in Yellow Box–Candlebark valley forest (31.1) under the abundant logs present.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Intact habitat link north to the Upper Plenty site. Fragmented links west to the Bald Hill site and south to the Silver Gum Park site. The site forms an important habitat link for mountain birds and ground mammals such as the Eastern Grey Kangaroo, Black Wallaby and Common Wombat between the Hume Ranges and the Merri and Plenty Volcanic Plains. The Barbers Creek connects southwards to River Red Gum grassy woodland (14.1) on the Plenty Lowland Volcanic Plains. Swamp Gum swampy riparian woodland (23.1), Swamp Gum swampy woodland (27.1) and Swamp Paperbark swamp scrub (17.1; now cleared), formerly extended downstream along the Bruces Creek floodplain onto the Plenty Upland Alluvial Plains.</p>	<p>Strengthen habitat links. As well as its inherent faunal values, the site is an important link for fauna with significant neighbouring areas (e.g. Plenty River Headwaters and Darebin and Barber Creeks units). Many of the habitat links are narrow strips of stream and roadside vegetation which require continual protective management. The areas most important to fence from livestock and revegetate are the streamways of the main tributaries of the Barber and Bruces Creeks.</p> <p>Several rare species which require large and remote areas of habitat are in danger of local extinction. These include the nesting Wedge-tailed Eagle, White-throated Nightjar, Rainbow Bee-eater, Speckled Warbler, Bassian Thrush, Brown Treecreeper and Spotted Quail-thrush (which was not seen but would be a winter visitor). These species are severely depleted in the foothills of NEM. The Yellow Box valley forest in the site, along with areas between Christmas Hills and Smiths Gully are the foothills strongholds of these species. Under concerted management which addresses land protection and conservation aspects these species may persist. The establishment of a system of grazing exclosures to link fragmented stands would break down the degree of isolation of faunal populations and greatly assist the conservation of these rare fauna species.</p>

Bushblock and farmlet subdivision. Unless appropriate regulatory controls and conditions for conservation management are established and enforced, the clearing and development of bushblocks for residential and small-acre farm subdivision are viewed as the major threats to biological values in the site.

Land degradation due to poor land capability/poor land management. On the basis of land protection and conservation, the site displays poor land capability for increased residential or rural development.

Protection of habitat/faunal values of Denkert's and the McNair Estate. The significant habitat and faunal values of blocks such as Denkert's bushland and the McNair Estate bushland should be protected and where possible enhanced. It is understood that the McNair Estate is bequeathed for conservation purposes and it forms a proposed outdoor education area for the Northern TAFE. Much conservation oriented work will be required on these blocks to balance the widespread local loss of broad-acre faunal values due to farm subdivision.

Regional Hydrological Strategy

Altered stream flow cycles due to tree clearing. Tree removal and understorey vegetation cover loss resulting from agricultural practices have severely altered the differential between the maximum winter and minimum summer flows (i.e. flow cycle). The more gradual runoff of the natural system after rainfall now becomes a flash event and water penetration of the soil profile decreases substantially (see salinity section). The forested lower catchments of streams once contained peat bogs and fern glades in their broad sheltered valleys. These perennially seeped into the feeder creeks of the streams. The clearing of these forests, loss of native understorey and damage to the substrate caused by livestock has caused the water seepage which fed streams between rainfall events to vanish.

The rate of erosion for this site was the most severe observed in NEM. Each of the processes described as a result of clearing and grazing in volume 1 was observed in the site.

Stock exclusion from high land hazard areas for land protection works. Streams, gullies and steep hills should be fenced-off to enable habitat enhancement and land protection programs such as natural regeneration and tree planting. Weed eradication, rabbit control and soil stabilisation programs reduce the levels of water contamination, salinity and soil erosion. The establishment of deep rooted perennial indigenous plants in soil erosion areas would allow more rain water to seep into the topsoil and decrease the amount that escapes beyond the subsoil. This will raise the soil organic matter and summer soil moisture levels. It would slow down the rate of sheet and gully erosion on the hill-slopes and lower the rates of turbidity and salination in the streams. In the long-term, under a sustainable grazing regime, these practices would provide more productive grazing land than at present.

Other Issues

Native vegetation clearance controls of existing habitat. The most important habitats to protect are stands of Yellow Box–Candlebark valley forest . All stands of native bushland should be protected from excessive grazing by livestock.

Require the formation of a community land protection group. Encourage landowners to participate in nature conservation, land protection and revegetation projects such as Land for Wildlife, LandCare, and Greening Australia. Fencing enclosures for stock to enable natural regeneration and replanting to occur are viewed as essential.

Site 94 Upper Plenty

- Map Reference:** 7923 280550 (Dry Creek at Clarkes Road); 7923 294529 to 7923 300575 (Bruces Creek). One minute lat/long grids include 37° 25' x 145° 01' to 145° 03', 37° 26' x 145° 01' to 145° 04' and 37° 27' x 145° 01' to 145° 04'.
- Location/Size:** Area to the west of Upper Plenty on both sides of the Whittlesea–Wallan Road. Approximately 1750 ha.
- Municipality:** City of Hume/Mitchell.
- Land Tenure/Use:** Public: roadsides. Private: livestock/stud farmlets, orchards and bushblocks.
- Landforms:** Mountain and foothill (see PUH C). Elevation is 220–360 m.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Messmate damp sclerophyll forest (4.2); Red Stringybark herb-rich foothill forest (6.1); Messmate herb-rich foothill forest (6.3); Manna Gum gully woodland (10.1); Messmate–Swamp Gum gully woodland (10.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Yellow Box–Candlebark valley forest (14. 6)

Rare species: Yarra Gum (Clarkes Road)

Notable features: The site provides an overlap of lowland and mountain forest habitats, but most are at least partially degraded. Messmate–Narrow-leaf Peppermint herb-rich foothill forest is more dominant than in the lower rainfall Eden Hills site to the south

FAUNAL SIGNIFICANCE: Site 94 Upper Plenty

Assessment: Regional—Category 2 (C, D, E, F)

Reference grids for the significance keys include:

94^a: 37° 25' x 145° 01'; Cleve Hill/Wallan East flats

94^b: 37° 25' x 145° 03'; Clarkes Road/Dry Creek, Upper Plenty

C. DIVERSITY: Species/Assemblage Richness–point census/trapping

k. Frogs

Regional. 94^a: 7 species including the Common Spadefoot Toad and Bibron's Toadlet on the Wallan East flats on 21 June 1991

m. Freshwater fish

Local. 94^b: 1 species electrofished from the Dry Creek by the Whittlesea–Wallan Road on 24 January 1989: Southern Pigmy Perch

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 94^a: 88 species. **94^b:** 73 species

b. Native birds

Regional. 94^a: 70 species. **94^b:** 65 species

c. Native mammals

Local. 94^a: 5 species. **94^b:** 2 species

d. Herpetofauna

Regional. 94^a: 13 species. **Local. 94^b:** 6 species

e. Freshwater fish

Regional. 94^a: 3 species. **Local. 94^b:** 1 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 94^b: 4 species. **94^a:** 3 species

c. Regionally vulnerable fauna (R2 species)

Regional. 94^b: 1 species. **Birds:** White-throated Gerygone

d. Regionally rare fauna (R3 species)

Regional. 94^b: 1 species. **Frogs:** Plains Froglet

Regional. 94^a: 1 species. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 94^a: 2 species. **Birds:** Peregrine Falcon. **Frogs:** Bibron's Toadlet

Regional. 94^b: 2 species. **Birds:** Leaden Flycatcher. **Fish:** Southern Pigmy Perch

f. Regionally restricted fauna (R5 species)

Local. 94^a: 2 species. **Reptiles:** Tussock Skink. **Frogs:** Common Spadefoot Toad

Local. 94^b: 2 species. **Birds:** Red-browed Treecreeper, White-winged Chough

F. POPULATION DENSITY: Viability and Abundance—point census

m. Regionally rare fauna (R3 species)

Regional. 94^a: about 100 Plains Froglets chorusing on the Wallan East flats, south-east of the corner of the Whittlesea–Wallan Road on 15 November 1988

Outlook

The faunal significance is declining due to bushblock settlement and lack of conservation management. The area was extensively cleared in the first 50 years of settlement and much of the bushland of today regenerated during a period of low land-use intensity between the 1950s and 1970s.

FAUNA

Please note: due to the area mostly occurring outside the NEROC municipal boundary and time or access (e.g. Cleve Hill) constraints, each location was visited only once (except Clarkes Road which was visited twice) for vegetation and rapid search fauna survey. No fauna trapping was undertaken. The Cleve Hill area was omitted from the site map but has been mapped within the management unit. It unquestionably functions as an important habitat link and would likely support regional faunal significance values. Species including the Powerful Owl might be expected to occur.

Other Significant Fauna

Birds

94^b: Dry Creek faunal corridor along Clarkes Road. The area near the Dry Creek bridge supports Messmate herb-rich foothill forest (6.3) on the sheltered hill-slopes, Manna Gum gully woodland (10.1) along Dry Creek, Messmate–Swamp Gum gully woodland (10.2) in gullies and Yellow Box–Candlebark valley forest (31.1) on the upper floodplain. The presence of grassy woodland in close proximity to the Messmate herb-rich foothill forest creates an overlap of lowland and upland species. The

Satin Flycatcher breeds in 10.2 while the Leaden Flycatcher breeds nearby in 31.1. A pair of White-throated Gerygone were breeding on 12 December 1986 in 11.1. The Crescent Honeyeater and Red-browed Treecreeper were seen at the bridge in 10.1.

Reptiles and frogs

94^a: Herpetofauna of the Wallan East flats. The low-lying alluvial flats by the Whittlesea–Wallan Road, just east of the Broadford–Wallan Road supports remnant vegetation. This includes Swamp Gum swampy woodland (27.1) on the flats, Yellow Box–Candlebark valley forest (31.1) flanking the valley and Yellow Box–Red Stringybark box–stringybark woodland (11.2) on the semi-cleared lower western slopes above the Broadford–Wallan Road. There is a strong representation of fauna of the volcanic plains (which lies about one kilometre to the west). These species include the Common Spadefoot Toad and Bibron’s Toadlet (calling on 21 June 1991) and Plains Froglet (calling on 15 November 1988). Other volcanic plains fauna includes the Tussock Skink. Both the Common Blue-tongued Lizard (of the plains) and Blotched Blue-tongued Lizard (of the hills) were recorded.

Freshwater fish

94^b: Electrofishing Survey: Dry Creek at Wallan Road

Map reference. 7923 282555. **Altitude.** 260 m. **Survey date.** 23 January 1989

Vegetation. Instream: submerged and emergent herbfield. Bank: Swamp Gum swampy riparian woodland (28.1). Frontage. Swamp Gum swampy woodland (27.1) and Yellow Box–Candlebark valley forest (31.1). Bank and frontage supports only remnant strata, in poor condition and with woody and grassy weeds

Physical Features:

Pools

Substrate. Silt on alluvial clay base

Maximum size (mid-summer). 3.0 m wide by 1 m deep by 30 m long

Riffles

Substrate. Cobbles on alluvial clay base

Flow (mid-summer normal): **Size.** 0.5 m wide by 2 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 0.95 ML/day

Water quality

Summer: Temperature. 20.0°C. Conductivity. 375 ms. Turbidity. Cloudy

Fish Recorded During Survey

Native species numbers/status. Southern Pigmy Perch (1); likely resident.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. An intact habitat link to the Bruces Creek–Dry Creek site and a fragmented link to the Eden Hills site. The site forms the main habitat link between the Hume Ranges and Merri Plains.</p>	
	<p>Strengthen habitat links. Habitat link enhancement is considered necessary for some faunal species (e.g. wider band of swampy riparian woodland along Bruces Creek for birds such as the Red-browed Treecreeper).</p>
Regional Hydrological Strategy	
<p>Electrofishing site. High turbidity/siltation rate. Stock faeces/enriched conditions have led to a high cover of algae. Severely depleted flow rate. Adjoining roadways. Severe nutrient enrichment. Steep eroding banks. The loss of bank vegetation and resultant erosion is due to livestock grazing as there is an inadequate set-back from the creek. Inadequate native instream and riparian cover. Severe bank erosion–slumping and gullying and tree and bank undercutting. Advancing weeds.</p>	<p>Monitoring effect of catchment timber production on the Bruces Creek. Forest hardwood production occurs upstream of the site in the mountain headwaters of the Bruces Creek north branch. This activity should be monitored so as to determine the impact on the neighbouring Plenty River Headwaters site and the water quality of Bruces Creek.</p>
Other Issues	
<p>Wildlife road-kills. The road between Upper Plenty and Wallan East is a crossing point for animals moving between the ranges and Eden Hills. It is one of worst areas for road-killed Common Wombats, Black Wallabies and Eastern Grey Kangaroos in NEM.</p>	<p>Speed restrictions required along Wallan Road. Traffic speed in this section should be reduced to 80 km/hour.</p> <p>Implementation of Native Vegetation Clearance Controls on private land.</p>

VOLUME 6

THE RANGES

Hume Ranges (HR)

HR A Bruces Creek–Plenty River West Branch Headwaters

Site 95 Bruces Creek–Dry Creek

Site 96 Falls Creek

HR B Plenty River Headwaters

Site 97 Joey Creek

Site 98 Mount Disappointment–Plenty River Headwaters

Site 99 Toorourrong Reservoir

HR C Scrubby Creek Headwaters–Sherwin Ranges

Site 100 Scrubby Creek Humevale

Kinglake Ranges (KR)

KR A Kinglake National Park West

Site 101 Arthurs Creek–Chadds Creek Headwaters

Site 102 Running Creek Headwaters

KR B Kinglake National Park East

Site 103 Diamond Creek Headwaters

Site 104 Steels Creek–Watsons Creek Headwaters

HABITATS of the Ranges

1.1. Cool Temperate Rainforest

Conservation status: regionally disjunct

Reference stands: 98^{bc}

Distribution: localised in HR B above 550 m elevation and 1200 mm rainfall in the Plenty River East Branch headwaters

Landforms: mountain—streams and wet gullies

Canopy: **Southern Sassafras–Myrtle Beech**; with Soft Tree-fern, Blanket-leaf, Silver Wattle, Blackwood, Mountain Grey Gum and Mountain Ash; 20–30 m tall and 30–50% cover

2.1. Wet Forest

Conservation status: regionally depleted

Reference stands: 98^{abc}, 104^a

Relatively intact and extensive stands: 101^{ad}, 103^a

Partially intact or small stands: 96^a, 101^c, 104^b

Distribution: widespread in HR B and restricted in HR A and KR; heavily cleared on the Kinglake plateau

Landforms: mountain—high elevation plateau above 600 m and wet valleys and slopes down to 350 m elevation

Canopy: **Mountain Ash**; with Mountain Grey Gum and Messmate; 40–80 m tall and 30–40% cover; apart from the Plenty River headwaters, largely regrowth with small stands of old-growth forest in Jehosaphat Gully and Full and Plenty Creek headwaters

3.1. Damp Riparian Forest

Conservation status: regionally secure

Reference stands: 97^{ab}, 98^{cd}, 103^a, 104^{ab}

Relatively intact and extensive stands: 95^a, 100^b, 101^{ad}, 102^a, 104^{cd}

Partially intact or small stands: 96^a

Distribution: widespread in HR and KR

Landforms: mountain and foothill—perennial streams and adjacent sheltered gullies above 300 m elevation

Canopy: **Mountain Grey Gum**; with Messmate, Narrow-leaf Peppermint, Mountain Ash, Manna Gum and occasional stands of Brown Stringybark (e.g. upper Ninks Road in the Diamond Creek headwaters); 30–60 m tall and 20–30% cover

4.1. Damp Sclerophyll Forest—plateau/spur

Conservation status: regionally secure

Reference stands: 97^b, 98^c, 103^b, 104^a

Relatively intact and extensive stands: 101^{abcd}, 102^a, 103^a, 104^b

Partially intact or small stands: 96^a, 98^d, 100^b

Distribution: widespread in HR and KR

Landforms: mountain—drier sections of the high elevation plateau and sheltered spurs at middle elevation

Canopy: Mountain Grey Gum; with Broad-leaved Peppermint, Messmate and Narrow-leaf Peppermint; 30–50 m tall and 20–30% cover

4.2. Damp Sclerophyll Forest—sheltered mountain slope

Conservation status: regionally secure

Reference stands: 97^b, 98^d, 102^a, 103^b, 104^b

Relatively intact and extensive stands: 95^a, 100^b, 101^{abcd}, 102^{ab}, 103^{ac}, 104^{acd}

Partially intact or small stands: 100^a

Distribution: widespread in HR and KR

Landforms: mountain—drier sections of the high elevation plateau and sheltered slopes and valleys at middle elevation; foothill—sheltered hill-slopes and gullies of ephemeral streams down to 250 m elevation

Canopy: Messmate; with Mountain Grey Gum, Narrow-leaf Peppermint and Manna Gum; 30–40 m tall and 30–40% cover

5.3. Riparian Forest—creek

Reference stands: 99^a, 104^{cd}

Relatively intact and extensive stands: 102^b

Partially intact or small stands: 95^b, 100^{ac}

Conservation status: regionally depleted

Distribution: restricted to the foothills of HR and KR

Landforms: foothill—streams and fern gullies below 300 m elevation

Canopy: Manna Gum; with Messmate, Swamp Gum and Narrow-leaf Peppermint; 20–40 m tall and 20–30% cover

6.1. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally depleted

Relatively intact and extensive stands: 102^b, 103^d, 104^e

Partially intact or small stands: 99^a, 100^{ac}, 104^{cd}

Distribution: localised at Toorourrong Reservoir and south-east of Humevale in HR and restricted in the southern foothills of KR

Landforms: foothill—sheltered hill-slopes at low elevation (below 250 m)

Canopy: Red Stringybark; with Long-leaf Box and Narrow-leaf Peppermint; Red Box at Wild Dog Creek and lower Watsons Creek areas of Kinglake NP and occasional Yellow Box and Candlebark in sections flanking valley forest; 15–20 m tall and 30–40% cover

6.3. Herb-rich Foothill Forest—sheltered hill-slope

Conservation status: regionally secure

Reference stands: 97^a, 98^d, 99^a, 102^b, 103^c, 104^c

Relatively intact and extensive stands: 95^a, 100^{ac}, 101^{bd}, 103^{bd}, 104^{bde}

Partially intact or small stands: 95^b, 100^b, 101^a

Distribution: restricted in HR and KR

Landforms: foothill—sheltered hill-slopes and valleys (below 350 m)

Canopy: Messmate; with Long-leaf Box, Red Stringybark, Swamp Gum, Narrow-leaf Peppermint and Manna Gum; 20–30 m tall and 30–40% cover

8.1. Heathy Forest

Conservation status: regionally secure

Reference stands: 97^b, 103^{bc}, 104^{bc}

Relatively intact and extensive stands: 100^c, 101^{bd}, 102^{ab}, 104^{de}

Partially intact or small stands: 95^a, 97^a, 98^d, 100^a, 103^a

Distribution: widespread in HR and KR

Landforms: mountain—exposed ridges, spurs and slopes generally in rainshadow at middle elevation (300–500 m); foothill—exposed hill-slopes, extending down to 240 m on north-easterly aspects along the Steels Creek–Mt Slide Road (e.g. Chalmers Ridge)

Canopy: Broad-leaved Peppermint; with Mealy Stringybark, Long-leaf Box, Red Stringybark and Messmate; 10–20 m tall and 20–30% cover

Comments: the moderately dense layer of low and ground cover shrubs (e.g. Creeping Grevillea and others listed under the related 19.1) characterises this community; 8.1 displaces Red Stringybark herb-rich foothill forest (6.1) on the hill-slopes above the Steels Creek–Mt Slide Road

9.1. Heathy Woodland

Conservation status: regionally threatened

Reference stands: 98^d, 103^{bc}

Relatively intact and extensive stands: 104^c

Partially intact or small stands: 95^a

Distribution: restricted in HR and KR; the most extensive stands occur on the western slopes of Mt Beggary and northern slopes of Mt Everard in Kinglake NP

Landforms: foothill—exposed hill-slopes (240–350 m elevation)

Canopy: Mealy Stringybark; with Broad-leaved Peppermint, Long-leaf Box, Red Stringybark and Cherry Ballart; 8–15 m tall and 10–30% cover

9.2. Heathy Woodland

Conservation status: regionally threatened

Reference stands: 103^c

Partially intact or small stands: 104^{bd}

Distribution: localised in KR to Broad Gully on the northern slopes of Mt Everard and flanking the valley of Steels Creek (where mostly cleared for farmland); 9.2 is more frequent in the Upper Yarra, NEM providing its western range limit

Landforms: foothill—seasonally waterlogged valleys and minor gullies (200–250 m elevation)

Canopy: Messmate–Green Scentbark; with Mountain Swamp Gum, Mealy Stringybark and Narrow-leaf Peppermint; 8–20 m tall and 10–30% cover

10.2. Gully Woodland—sheltered valley/gully

Conservation status: regionally depleted

Reference stands: 97^a, 98^d, 99^a, 103^{cd}

Relatively intact and extensive stands: 95^a, 100^{abc}, 101^b, 102^b, 104^{ce}

Partially intact or small stands: 95^b, 104^d

Distribution: restricted to the southern margin of HR and KR

Landforms: foothill—upper floodplains of perennial streams and to about 300 m elevation along minor streams and in sheltered gullies and valleys

Canopy: **Messmate**; with Mountain Swamp Gum (KR), Mealy Stringybark, Swamp Gum, Narrow-leaf Peppermint and Manna Gum; occasional stands of Green Scentbark (*E. fulgens*; e.g. Steels Creek) and Yarra Gum (e.g. Bruces Creek); 15–30 m tall and 20–30% cover

11.1. Box–Stringybark Woodland—hill-crest

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 103^d

Distribution: localised in KR; small extensions on Silurian mudstone/siltstone into the southern perimeter of Kinglake NP along the St Andrews anticline at Wild Dog Creek and on Devonian siltstone along Marshalls Road and the Watsons Creek

Landforms: foothill—exposed hill-slopes and hill-crests at low elevation (below 300 m)

Canopy: **Red Box–Red Stringybark**; with Long-leaf Box; 15–20 m tall and 20–30% cover

11.4. Box–Stringybark Woodland—ridge

Conservation status: regionally depleted

Reference stands: 97^a, 102^b, 104^e

Relatively intact and extensive stands: 100^c, 101^b, 103^c, 104^d

Partially intact or small stands: 95^a, 98^d, 99^a, 100^a, 101^d

Distribution: restricted to the southern margin HR and KR

Landforms: foothill—exposed ridges, hill-crests and hill-slopes from 220–350 m elevation

Canopy: **Long-leaf Box–Red Stringybark**; with Broad-leaved Peppermint and Messmate; 15–20 m tall and 20–30% cover

Comments: the Silvertop Wallaby-grass–Grey Tussock-grass field layer varies from open (10–20% cover) in exposed situations to dense (40–70% cover) in sheltered situations while the low shrub layer of wattles and shrub peas is relatively diverse and varies from sparse to moderately dense depending on wallaby grazing pressure. Thatch Saw-sedge can dominate gully saddles and mid-slope seepage areas. Tall shrubs are sparse apart from sandstone areas (e.g. below Bald Spur lookout in Kinglake NP). 11.4 grades into heathy forest (8.1) at higher elevation and heathy woodland (9.1) when present at lower elevation.

19.1. Upland Scrub

Conservation status: regionally disjunct

Reference stands: 101^d, 103^c

Distribution: localised in KR at Bald Spur lookout and the spur running north-west from Mt Everard in Kinglake NP

Landforms: mountain—exposed razorback spurs in rainshadow areas of 450–500 m elevation

Canopy: **Broad-leaved Peppermint**; with Mealy Stringybark, Long-leaf Box, Red Stringybark and Cherry Ballart; 20–40% cover and 4–8 m tall

Character understory plants: shrubs include Austral Grass-tree, Common Cassinia, Trailing Ground-berry, Honey-pots, Common Heath, Pink Beard-heath, Prickly Broom-heath, Narrow-leaf Bitter-pea, Gorse Bitter-pea, Small-leaf Parrot-pea, Golden Bush-pea, Blue Dampiera, Narrow-leaf Wattle, Rosy Baeckea and Silver Banksia. Herbs include Black-anther Flax-lily, Grey Tussock-grass, Silvertop Wallaby-grass and Wattle Mat-rush. On Silurian sandstone at Bald Spur the habitat contains a denser field and low shrub layer (30% cover for each, half of which is provided by ground shrubs and grasses) than at Mt Everard (Devonian siltstone).

20.1. Cliff/Escarpment Shrubland—sheltered

Conservation status: regionally disjunct

Reference stands: 102^a

Distribution: localised in KR A (downstream of Masons Falls)

Landforms: foothill—sheltered waterfall cliff faces of Devonian mudstone (250-350 m elevation)

Canopy: **Blanket-leaf–Musk Daisy-bush–Blackwood;** with Rough Tree-fern, Common Cassinia, Prickly Moses, Sweet Bursaria, Hazel Pomaderris and Prickly Currant-bush and scattered emergent Mountain Grey Gum and Narrow-leaf Peppermint; 2–8 m tall and 0–20% cover

Character field layer plants: Common Maiden-hair, Green Rock Fern, Necklace Fern, Common Rasp-fern, Austral Bracken, Mother Shield-fern, Variable Sword-sedge, Tasman Flax-lily, Grey Tussock-grass, Forest Wire-grass, Thatch Saw-sedge, Cut-leaf Daisy, Golden Everlasting, Clustered Everlasting, Wonga Vine, Prickly Starwort, Shade Plantain, Mountain Clematis, Bidgee-widgee, Small-leaf Bramble, Derwent Speedwell, Grass Trigger-plant and Ivy-leaf Violet (0–10% cover low shrubs, 10–20% cover herbs and 50–90% cover of bare rock)

Comments: shrubs occur at the edges and base while central areas are composed of sheer faces of bare rock with herbfield on ledges and in rills

20.3. Cliff/Escarpment Shrubland—exposed

Conservation status: regionally disjunct

Reference stands: 102^a

Distribution: localised in KR A downstream of Masons Falls

Landforms: foothill—exposed waterfall cliff faces of Devonian mudstone (250–350 m elevation)

Canopy: **Gorse Bitter-pea–Varnish Wattle–Dusty Miller;** with Small-leaf Parrot-pea, Hop Goodenia, Burgan, Common Correa, Cherry Ballart and Pale-fruit Ballart and scattered emergent Broad-leaved Peppermint, Long-leaf Box and Red Stringybark; 1–5 m tall and 10–20% cover

Character field layer plants: Variable Sword-sedge, Black-anther Flax-lily, Silvertop Wallaby-grass, Kangaroo Grass, Wattle Mat-rush, Hoary Sunray, Variable Groundsel, Honey-pots, Common Heath, Purple Coral-pea, Common Raspwort and Creeping Grevillea; 20–30% cover low shrubs and 20–30% cover herbs and 20–50% cover of bare rock

21.1. Damp Heath

Conservation status: regionally disjunct

Reference stands: 103^c

Distribution: localised in KR B on the north-facing (southern) flank of Broad Gully between Mt Beggary and Mt Everard; grades upslope into Mealy Stringybark (dry tea-tree) heathy woodland and downslope into Messmate (damp tea-tree) heathy woodland

Landforms: foothill—valley (flats and foot-slopes) associated with Devonian siltstone/red duplex peaty soils with sub-surface seepage from higher areas and impeded drainage due to an impermeable clay horizon (250 m elevation)

Canopy: Mealy Stringybark, Broad-leaved Peppermint, Long-leaf Box, Red Stringybark and Cherry Ballart; 8–12 m tall and 10% cover

Character understorey plants: **Swamp Bush-pea–Heath Tea-tree–Common Heath** with Thatch Saw-sedge, Wiry Spear-grass and Small Grass-tree (low shrubs and herbs both 30-50% cover). **Tall shrubs:** Scrub Sheoke, Prickly Tea-tree, Hairpin Banksia and Pale-fruit Ballart. **Low shrubs:** Common Beard-heath, Smooth Parrot-pea, Small-leaf Parrot-pea, Blue Dampiera, Woolly Wattle, Rosy Baeckea, Heath Milkwort, Silver Banksia, Cat's Claws Grevillea, Furze Hakea, Horny Cone-bush and Prickly Geebung. **Herbs:** Common Rapier-sedge, Wire Rapier-sedge, Tortuous Rapier-sedge, Hair-sedge, Slender Bog-sedge, Milkmaids, Grey-beard Grass, Spreading Rope-rush, Small Swamp-daisy, Button Everlasting, Tiny Sundew, Scented Sundew, Slender Dodder-laurel and Grass Trigger-plant.

25.5. Seasonal Wetland—floodplain herbfield

Conservation status: regionally depleted

Reference stands: 99^a

Distribution: localised in HR B at inlets of Toorourrong Reservoir

Landforms: artificial waterbodies

Character species: **Sword Tussock-grass–Tall Sedge;** with Common Spike-sedge

25.7. Seasonal Wetland—emergent herbfield

Conservation status: regionally secure

Reference stands: 99^a

Relatively intact and extensive stands: nil

Partially intact or small stands: 102^b

Distribution: localised in HR B and KR A to the shoreline and inlets of Toorourrong and Running Creek Reservoirs

Landforms: artificial waterbodies

Character species: **Common Reed–Cumbungi–Tall Spike-sedge;** with Leafy Flat-sedge, Tassel Sedge, Fen Sedge, Common Spike-sedge, Tall Rush, Floating Pondweed, Water-ribbons, Australian Lilaeopsis, Upright Milfoil, Purple Loosestrife and Small Mud-mat at Toorourrong

26.1. Permanent Wetland—submerged/floating herbfield

Conservation status: regionally secure

Reference stands: nil

Relatively intact and extensive stands: 99^a

Partially intact or small stands:

Distribution: localised in HR B in the shallows of Toorourrong Reservoir

Landforms: artificial waterbodies

Character species: **Blunt Pondweed–Lake Eel-grass;** with Pacific Azolla, Common Duckweed

31.1. Valley Forest

Conservation status: regionally depleted

Reference or relatively intact and extensive stands: nil

Partially intact or small stands: 95^b, 99^a, 100^c

Distribution: localised in HR (e.g. Toorourrong Reservoir); extending from the lower rainfall Plenty Upland Alluvial Plains

Landforms: foothill—valleys of low elevation (below 250 m)

Canopy: Yellow Box–Candlebark; with Long-leaf Box, Red Stringybark, Messmate and Narrow-leaf Peppermint; 15–20 m tall and 25–40% cover

GEOLOGICAL and LANDFORM/SOIL TYPES of the Ranges

Silurian Siltstone/Mudstone

Distribution: KR B (small extension from the south into the Kinglake NP along the St Andrews anticline at Wild Dog Creek)

Landform/Soil Types

Foothill: hill-crests and exposed hill-slopes/shallow, stony brown gradational; sheltered hill-slopes/yellow duplex.

Silurian Sandstone

Distribution: HR A (between Upper Plenty and White Elephant Gap and connecting the Kilmore Gap in the Great Dividing Range between Wallan and Wandong); HR B (foothills north of Glenvale); KR A (Bowden Spur and valley of Arthurs Creek associated with the Templestowe anticline and Bald Spur associated with the St Andrews anticline); KR B (Mt Beggary and valleys of Diamond Creek associated with the St Andrews anticline and Yarra Ridge and valley of Steels Creek associated with the Yarra anticline)

Landform/Soil Types

Mountain: spurs, ridges, sheltered slopes/deep yellow gradational; exposed slopes/shallow yellow gradational

Foothill: hill-crests and exposed hill-slopes/shallow stony, brown gradational; sheltered hill-slopes/yellow duplex with shallow grey loam topsoil.

Devonian Granodiorite

Distribution: HR A and HR B (Mt Disappointment Plateau)

Landform/Soil Types

Mountain: plateau and upper, sheltered slopes/deep friable red gradational; steep, sheltered slopes/brown gradational.

Devonian Siltstone

Distribution: HR A (Mt Disappointment Plateau between Red Hill and Mt Disappointment); HR B (Jack and Joey Creek catchments of the Kinglake Plateau); HR C (Coombs Road Spur of the Kinglake Plateau); KR A (west of Bowden Spur of the Kinglake Plateau); KR B (Everard Spur of the Kinglake Plateau, Watsons Creek headwaters and Mt Jerusalem Spur/Mt Slide Spur of the Kinglake Plateau; associated with the Mt Beggary syncline)

Landform/Soil Types

Mountain: Kinglake Plateau, spurs and upper sheltered slopes/deep friable red gradational; steep, sheltered slopes/yellow gradational; ridges and exposed slopes/shallow stony, brown gradational; valleys/brown gradational; lower elevation sheltered slopes and saddles/red duplex

Foothill: exposed spurs, slopes, hill-crests and ridges/shallow yellow gradational; sheltered hill-slopes/yellow duplex.

Quaternary Colluvium

Distribution: HR A; HR B; HR C; KR A; KR B (e.g. Broad Gully)

Landform/Soil Types

Foothill: broad valley flats and lower hill-slopes/red duplex (peaty-loam topsoil derived from Devonian siltstone in areas of impeded drainage) or yellow duplex with shallow grey loam topsoil (derived from Silurian siltstone); gullies/yellow gradational.

Quaternary Alluvium

Distribution: HR A (Bruces Creek, Plenty River West Branch); HR B (Plenty River East Branch/Toorourrong Reservoir); HR C (Scrubby Creek); KR A (Running and Arthurs creeks); KR B (Diamond, Jehosaphat, Steels and Watsons Creeks)

Landform/Soil Types

Mountain: stream valleys and floodplains/brown gradational loam

Foothill: stream floodplains/yellow duplex (with deep, grey loam topsoil); Toorourrong Reservoir/peaty-silt deposits fringing the reservoir.

The vegetation change associated with the Silurian sandstone to Devonian siltstone transition is evident along the Everard Spur walking track from the Old Kinglake Road car park to Mt Everard. The first section is a sandstone ridgeline (Mt Beggary). This contains a grass and low shrub cover of about 50%. Mt Everard is formed of Devonian siltstone. This contains a bare earth and rock cover of over 70% and a low shrub and field layer vegetation cover of less than 30%.

HUME RANGES (HR)

Mountain forest catchments of the Plenty River, Bruces Creek and Scrubby Creek headwaters.

Land-use

Past land-use: pastoral (foothills), townships, timber harvesting and water reserves. Present land-use: townships, water reserves, timber harvesting, bushblock and farmlet settlement, bushland and recreation (e.g. Whittlesea golf course and Toorourrong Reservoir picnic area).

Native vegetation cover

Extensive except at the margin of the cleared plateau and softwood plantations at Kinglake West and in the foothills at Humevale.

Key biological features

Lewin's Rail, Baillon's Crake, Little Bittern, Blue-billed Duck, Grey Goshawk, Sooty Owl, Barking Owl, Powerful Owl, Superb Lyrebird, Eastern Whipbird, Pilotbird, Satin Bowerbird, Platypus, Brush-tailed Phascogale, Dusky Antechinus, Greater Glider, Eastern False Pipistrelle, Mountain Dragon, Spencer's Skink, Mountain Galaxias, Freshwater Blackfish and Mountain Skipper and Victorian Hair-streak butterflies and Creeping Grevillea, Fairy Lanterns and Butterfly Orchid; cool temperate rainforest/fern galleries and wet sclerophyll, damp riparian, damp sclerophyll, riparian, herb-rich foothill (Messmate and Red Stringybark) and heathy forests; faunal, habitat and orchid rarity, abundance and diversity; wet mountain forest ecological reference areas; and strategic habitat links between the ranges and upland hills.

Key areas/physical features for biota

Mt Disappointment, Plenty River, Bruces Creek, Scrubby Creek, Joey Creek, Jack Creek and Toorourrong Reservoir.

6 sites of significance: 5 state and 1 regional for fauna and 1 very high, 3 high and 2 medium for habitat.

HR A BRUCES CREEK–PLENTY RIVER WEST BRANCH HEADWATERS

This management unit consists of one site of state faunal significance (site 95) and one of regional faunal significance (site 96) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

- Map Reference:** 7923 300573 to 7923 337583 (Bruces Creek); 7923 292575 to 7923 297610 (Dry Creek); 7923 321538 to 7923 333580 (Plenty River West Branch–Falls Creek).
- Location/Size:** Timbered catchments of the upper Bruces Creek and Plenty River West Branch. The northern boundary is the South Mountain and Disappointment Roads on the spine of the Great Dividing Range. Approximately 3800 ha.
- Municipality:** City of Whittlesea and City of Mitchell.

Physical Features

The management unit occurs at the western end of the Eastern Uplands physiographic region of the Great Dividing Range. It forms the point of convergence of several physiographic regions and biophysical zones. The alluvial plains and volcanic plains sections of the Eastern Uplands lie to the south. The Merri Upland Volcanic Plains and upper Merri Creek valley of the Kilmore Gap separates the unit to the west from the Western Uplands and to the north from the Northern Plains (the riverine plains of the Goulburn River valley).

Landforms

Mountain: plateau, spurs, ridges, slopes, valleys (strongly dissected), gullies and streams/headwaters. Foothill: hill-crests, hill-slopes, valleys, gullies, streams and dams. Elevation is 260–760 m.

Hydrology

The main tributaries of the Plenty River West Branch and Bruces Creek are fast-flowing perennial mountain streams draining the southern mountain slopes of the Great Dividing Range.

Rainfall: 750–1000 mm (grading from west to east).

Site 95 Bruces Creek–Dry Creek

- Map Reference:** 7923 300575 to 7923 306592 (Bruces Creek); 7923 292575 to 7923 293596 (Dry Creek); 7923 302582 (Bruces Creek at Mill Range Road). One minute lat/long grids include 37° 23' x 145° 04' to 145° 05', 37° 24' x 145° 04' to 145° 05' and 37° 25' x 145° 04' to 145° 05'.
- Location/Size:** Approximately 750 ha.
- Municipality:** City of Mitchell.
- Land Tenure/Use:** Public: State Forest (NRE) in the northern section managed for hardwood production. Private: southern section containing uncleared or regrowth bushland. Dwellings are being erected on small bushblocks (of around 8 ha).
- Landforms:** Mountain and foothill (see HR A). Elevation is 260–560 m.

Natural Heritage Values

Landscape. The site supports biogeographically distinct landforms/vegetation types (e.g. damp sclerophyll forest and box–stringybark woodland). Similar to the adjacent Upper Plenty site, the lower elevation section of the Bruces Creek–Dry Creek site contains a diverse assemblage of lowland and foothill woodland/forest fauna species. The Mill Range Road bridge on Bruces Creek lies at about 300 m elevation and is situated between two southern spurs of the ranges. This section of the stream contains some of the most intact and significant foothills riparian habitat in NEM.

The Mill Range Road bridge separates the end of a narrowly dissected mountain valley (upstream) and the head of a broad floodplain (downstream at Glenvale). The area contains an overlap of distinct bands of vegetation shaped by altitude, soil type/moisture and aspect. Downstream of the bridge, Yellow Box–Candlebark valley forest (31.1) occupies the upper valleys, Messmate gully woodland (10.2) the upper floodplain and Manna Gum riparian forest (5.3) occurs along the creek. Upstream of the bridge there is a much stronger representation of mountain forest types with Messmate damp sclerophyll forest (4.2) on the sheltered hill-slopes and Mountain Grey Gum damp riparian forest (3.1) along the stream. Mealy Stringybark heathy woodland (9.1) occupies the exposed valleys.

As Mill Range Road ascends from Bruces Creek bridge it passes from dry through damp and finally to wet forest. The road crosses from the sheltered eastern side of the spur at the bridge to the exposed western aspect and then up along the spur. This section shows altitudinal bands of vegetation similar to that along Bald Spur in Kinglake NP. Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) occupies the ridgeline of the spur at lower elevation. This grades into Broad-leaved Peppermint heathy forest (8.1) at about 350 m. Below the plateau between about 500 m to 600 m there is a band of Mountain Grey Gum damp sclerophyll forest (3.1), while Mountain Ash wet forest (2.1) appears on the plateau. In the Bruces Creek valley Mountain Ash descends to about 450 m.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point in Bruces Creek at Mill Range Road.

HABITAT SIGNIFICANCE

Assessment : Medium—Category 2

Relatively intact and extensive stands: Mountain Grey Gum damp riparian forest (3.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Messmate–Swamp Gum gully woodland (10.2)

Partially intact or small stands: Broad-leaved Peppermint heathy forest (8.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Notable features: Strategic Habitat Link. Riparian vegetation of Bruces Creek upstream of Mill Range Road

FAUNAL SIGNIFICANCE Site 95 Bruces Creek–Dry Creek

Assessment : State—Category 3 (F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

95^a: 37° 24' x 145° 04'; Bruces Creek/Mill Range/Dry Creek

95^b: 37° 25' x 145° 04'; Bruces Creek/Conical Hill

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

Regional. 95^a: Eastern Horseshoe-bat; trapped along Dry Creek (non-roosting record)

c. Rare fauna

Regional. 95^a: Mountain Galaxias. **95^b:** Barking Owl at Lords Road (Conical Hill)

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 95^b: 5 species including the Southern Forest Bat and Chocolate Wattled Bat at Conical Hill on 28 March 1988

j. Ground mammals

Regional. 95^b: 5 species including the Brown Antechinus and Bush Rat at Conical Hill on 28 March 1988

l. Reptiles

Regional. 95^a: 8 species including the McCoy's Skink, Delicate Skink, Eastern Three-lined Skink and Southern Water Skink on Bruces Creek at Mill Range Road on 24 January 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 95^a: 83 species

b. Native birds

Regional. 95^a: 54 species. **95^b:** 50 species

c. Native mammals

Regional. 95^b: 15 species. **95^a:** 11 species

d. Herpetofauna

Regional. 95^a: 18 species. **Local. 95^b:** 7 species (5 frog species)

e. Freshwater fish

Local. 95^a: 1 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 95^a: 10 species. **95^b:** 3 species

b. Regionally endangered fauna (R1 species)

Regional. 95^a: 1 species. **Mammals:** Eastern Horseshoe Bat

c. Regionally vulnerable fauna (R2 species)

Regional. 95^a: 1 species. **Birds:** White-throated Nightjar.

Regional. 95^b: 1 species. **Birds:** Barking Owl

d. Regionally rare fauna (R3 species)

Regional. 95^a: 3 species. **Birds:** Spotted Quail-thrush. **Reptiles:** Coventry's Skink, White-lipped Snake

Regional. 95^b: 1 species. **Birds:** Spotted Quail-thrush

e. Regionally depleted fauna (R4 species)

Regional. 95^a: 5 species. **Birds:** Australian King-Parrot, Superb Lyrebird. **Mammals:** Platypus.
Reptiles: White's Skink. **Fish:** Mountain Galaxias

Local. 95^b: 1 species. **Birds:** Superb Lyrebird

f. Regionally restricted fauna (R5 species)

Regional. 95^a: 10 species. **Birds:** Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Red-browed Treecreeper, White-winged Chough. **Reptiles:** Delicate Skink, McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

Local. 95^b: 2 species. **Birds:** White-winged Chough. **Mammals:** Koala

g. Nesting birds of prey/parrots

Regional. 95^a: Gang-gang Cockatoo (Messmate)

F. POPULATION DENSITY: Viability and Abundance—point census

i. Bat trapping rate

Regional. 95^b: 23 bats of 5 species from one trap-night at Conical Hill on 28 March 1988

j. Electrofishing rate

State. 95^a: 1000 Mountain Galaxias from Bruces Creek at Mill Range Road on 24 January 1989

n. Regionally depleted fauna (R4 species)

Regional. 95^a: See Fj

Outlook

The faunal significance is designated as State due to the population of Mountain Galaxias in Bruces Creek at Mill Range Road. The site also meets 17 sub-criteria for Regional significance in all five criteria. The regional values should continue to be maintained. The galaxias population should be closely monitored, particularly with regard to effects on water quality in the stream from logging in the catchment. The faunal significance would be maintained if catchment logging were excluded from the streamway of major tributaries of Bruces Creek (in accordance with the Regional Habitat Link/Hydrological Strategies).

FAUNA

Rare or Threatened Fauna

- Bb* **95^a: Eastern Horseshoe Bat.** One was trapped on 28 March 1988 along Dry Creek some 17 km SSW of its nearest known roosting site at Reedy Creek (north of the study area). This bat is known from only two roost sites in GM. These are at One Tree Hill Mine and Mount Slide Road Mine, 31 km to the SSE and SE respectively (refer also Mansergh *et al.* 1989). Little is known about the movements of this bat. It is possible that regular movement takes place between these (and other unknown) roosting sites. During transit it is likely that the species follows timbered stream corridors such as Dry Creek. The retention of habitat links between roosting sites may be critical to the survival of the species in GM.
- Bc* **95^b: Barking Owl.** A road-killed Barking Owl was found on Lords Road outside the Kalangadoo Trail Ride farm on 18 February 1990. The area contained Yellow Box–Candlebark valley forest (31.1)..
- Bc* **95^a:** Mountain Galaxias (see *Fj*).

Critical Assemblages or Populations

- Fj* **95^a: High population density of Mountain Galaxias.** The middle reaches of Bruces Creek contains the largest population of Mountain Galaxias recorded in NEM. This is indicative of high water quality and intact riparian substrate and vegetation (Bill O'Connor pers. comm.). Over 1000 galaxias were recorded in Mountain Grey Gum damp riparian forest (3.1) above and below the Mill Range Road bridge in about 40 minutes electrofishing (McKenzie & O'Connor 1989).

Other Significant Fauna

Birds

- Ec* **95^a: White-throated Nightjar and other ground birds of the exposed Mill Range Road ridge.** The Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) and Broad-leaved Peppermint heathy forest (8.1) along Mill Range Road supports the Painted Button-quail, White-throated Nightjar and Spotted Quail-thrush.
- Ee/Ef* **95^a: Superb Lyrebird and other mountain forest birds at Bruces Creek crossing of Mill Range Road.** The Messmate herb-rich foothill forests (16.3) support a diverse assemblage of damp forest species representative of the ranges (e.g. Brush Bronzewing, Brush Cuckoo, Superb Lyrebird, Rufous Fantail, Rose Robin and Red-browed Treecreeper). The lyrebird is nearing the western end of its range. The catchment forests link to larger stands of wet forest in the Plenty River headwaters.

Despite severance of habitat links, winter movement of mountain parrots occurs into lowland grassy woodlands of the plains of the Barber and Darebin Creeks (e.g. Gang-gang Cockatoo, Yellow-tailed Black-Cockatoo and Australian King-Parrot). A flock of 15 Yellow-tailed Black-Cockatoos was seen feeding on Blackwood gall wasp larvae in Mountain Grey Gum damp riparian forest (3.1) at the Bruces Creek bridge on Mill Range Road on 24 January 1989.

Mammals

- Ef* **95^b: Koala.** One was seen in Messmate gully woodland (10.2) to the east on Conical Hill on 23 June 1988. This species is locally rare. Road-kills have been recorded on the nearby Whittlesea–Wallan Road. Habitat links to the Plenty Upland Hills and Alluvial Plains are severed. A population increase similar to that occurring in the foothills of the Kinglake Ranges is unlikely.

Reptiles

Ed/Ee **95^a: White's Skink and other reptiles of the exposed Mill Range Road ridge.** The Broad-leaved Peppermint heathy forest (8.1) along Mill Range Road contains the White's Skink and Coventry's Skink. The Mountain Dragon is probably present.

Freshwater fish

95^a: Electrofishing Survey: Bruces Creek at Mill Range Road

Map reference. 7923 302582. **Altitude.** 340 m. **Survey date.** 24 January 1989.

Vegetation: Instream. No submerged or emergent herbfield. **Bank.** Mountain Grey Gum damp riparian forest (3.1; some Blackberry invasion; varied herbs 10% cover; excellent condition).

Frontage. Messmate herb-rich foothill forest (6.3; good condition with grassy herbs)

Physical Features: Substrate. Silt and cobbles on sheet siltstone; undercut banks.

Maximum size (mid-summer). 3.0 m wide by 0.4 m deep by 20 m long.

Substrate. Silt and cobbles on sheet siltstone.

Flow (mid-summer normal): Size. 1.0 m wide by 10 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 9.5 ML/day.

Water Quality: Summer: Temperature. 16.0°C. **Conductivity.** 100 ms. **Turbidity.** Clear.

Fish Recorded During Survey:

Native species numbers/status. Mountain Galaxias (1000); breeding resident.

Alien species numbers/status. Nil.

Other comments. The freshwater crustacean, *Euastacus yarraensis* was recorded at the electrofishing site (Tarmo Raadik pers. comm.). This is an important prey item of the Platypus, which was recorded in a return visit on 18 December 1991.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Connectivity. Strategic Habitat Link for fauna moving between the ranges and the plains (e.g. between the Plenty River headwaters and Kinglake NP to the Merri Volcanic Plains and Plenty Alluvial Plains).</p>	
<p>Deterioration of biological values through bushblock subdivision. There has been an increase in the number of bushblock properties and trail-ride farms in the foothills over the last decade. Many have taken up abandoned farmland which had substantially rehabilitated and regenerated. Some are rather intensively grazed and large dams are being installed, adding to the chronic lack of water flow and declining water quality of the middle sections of the Plenty River West Branch and Bruces Creek. Unless appropriate regulatory controls and conditions for conservation management are established and enforced, this clearing, development and small-acre farm subdivision are the major threats to biological values in the site.</p>	<p>Strengthen Strategic Habitat Link. As well as its intrinsic faunal values, the site is a Strategic Habitat Link for fauna moving between the ranges and the plains. Many of the habitat links to the plains are narrow strips of stream and roadside vegetation which require enhancement and continual protective management.</p>
Regional Hydrological Strategy	

Mountain forest catchment hardwood production and the hydrological cycle.

Hardwood production occurs in the forested headwaters of the site. Blackberry is establishing along the stream. The combined effects of the associated processes (see volume 1) have changed second and third order streams from perennial to intermittent. This has restricted the breeding and feeding opportunities of native fish.

Monitor adherence to prescription logging activities.

Logging activities in the catchment should be monitored to determine their impact on the neighbouring Plenty River Headwaters site and the water quality of Bruces Creek. Because the Bruces Creek headwaters have not been as extensively logged as the Falls Creek site to the east, siltation levels in Bruces Creek are low and populations of the Mountain Galaxias remain high. Increased logging, burning off and uncontrolled fires in the catchment would likely lead to an increase of up to 50% in runoff and greatly increase the level of stream siltation and channel erosion (Cadwallader & Backhouse 1983).

Site 96 Falls Creek

- Map Reference:** 7923 322542 to 7923 333580 (Plenty River West Branch–Falls Creek). One minute lat/long grids include 37° 24' x 145° 06', 37° 25' x 145° 06' and 37° 26' x 145° 06'.
- Location/Size:** Headwaters of Falls Creek and Plenty River West Branch, 2 km west of the summit of Mt Disappointment. Approximately 470 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: State Forest (NRE) managed for hardwood production.
- Landforms:** Mountain (see HR A). Elevation is 300–650 m.

Natural Heritage Values

Landscape. The gullies and streams contain fragmented stands of unlogged wet forest and damp riparian forest. These support much of the biological significance of the site.

HABITAT SIGNIFICANCE

Assessment: Medium—Category 2

Partially intact or small stands: Mountain Ash wet forest (2.1), Mountain Grey Gum damp riparian forest (3.1), Mountain Grey Gum damp sclerophyll forest (4.1)

FAUNAL SIGNIFICANCE: Site 96 Falls Creek

Assessment: Regional—Category 1 (C, D, E, F)

Reference grids for the significance keys :

96^a: 37° 24' x 145° 06'; Falls Creek

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 96^a: 5 species including the Gould's Long-eared Bat and Eastern False Pipistrelle at Hilliers Road/Link Track on 18/19 December 1991

i. Arboreal mammals

Regional. 96^a: 4 species including the Mountain Brushtail Possum and Greater Glider at Hilliers Road/Link Track on 18/19 December 1991

j. Ground mammals

Regional. 96^a: 5 species including the Dusky Antechinus and Bush Rat at Hilliers Road/Link Track on 18/19 December 1991

k. Frogs

Local. 96^a: 4 species including the Victorian Smooth Froglet, Southern Toadlet and Striped Marsh Frog at Hilliers Road/Link Track on 18/19 December 1991

l. Reptiles

Regional. 96^a: 9 species including the McCoy's Skink, Coventry's Skink, Southern Grass Skink, Spencer's Skink and White-lipped Snake at Hilliers Road/Link Track on 18/19 December 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 96^a: 82 species

b. Native birds

Regional. 96^a: 54 species

c. Native mammals

Regional. 96^a: 14 species

d. Herpetofauna

Regional. 96^a: 14 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 96^a: 23 species

c. Regionally vulnerable fauna (R2 species)

Regional. 96^a: 2 species. **Birds:** Blue-winged Parrot, Satin Bowerbird

d. Regionally rare fauna (R3 species)

Regional. 96^a: 12 species. **Birds:** Pink Robin, Large-billed Scrubwren, Pilotbird. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Greater Glider, Gould's Long-eared Bat, Eastern False Pipistrelle. **Reptiles:** Spencer's Skink, Coventry's Skink, Southern Grass Skink, White-lipped Snake

e. Regionally depleted fauna (R4 species)

Regional. 96^a: 3 species. **Birds:** Superb Lyrebird, Bassian Thrush, Eastern Whipbird

f. Regionally restricted fauna (R5 species)

Regional. 96^a: 8 species. **Birds:** Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

g. Nesting birds of prey

Regional. 96^a: Wedge-tailed Eagle

F. POPULATION DENSITY: Viability and Abundance—point census

l. Regionally vulnerable fauna (R2 species)

Regional. 96^a: 6 Blue-winged Parrots at Hilliers Road/Link Track on 18/19 December 1991

m. Regionally rare fauna (R3 species)

Regional. 96^a: 10 Large-billed Scrubwrens and 10 Coventry's Skinks at Hilliers Road/Link Track on 18/19 December 1991

Outlook

The faunal significance would increase if logging were excluded from within 100 m of Falls Creek and its tributaries (in accordance with the Regional Habitat Link/Hydrological Strategies).

FAUNA

Other Significant Fauna

Birds

96^a: Old-growth and logging coupe Mountain Ash bird census

The birds of successional Mountain Ash wet forest (2.1) have been well studied in Victoria (e.g. Loyn 1985a). Many species colonise regrowth within five years of harvesting operations. Two 40-minute bird counts covering 5 ha were conducted on consecutive days in mid-December 1991 at 640 m elevation. The

area lies between Falls Creek and Plenty River West Branch headwaters along Hilliers Road. Most of the species present were breeding.

96^a: Logging coupe summary. One count was in a regrowth coupe (second year since logging) and the other was in an adjacent steep, unlogged gully. The coupe contained logging debris, scrub 2 to 3 m high (regenerating ash and broad-leaved shrubs), extensive development of low shrubs (e.g. Common Cassinia, Hop Goodenia and Austral Bracken), and Forest Wire-grass and scattered old trees. Coupes are clearfelled, as successful regeneration of ash seedlings requires full sunlight created by a hot burn and substantial canopy removal (Ashton 1956). Artificial seeding is conducted.

96^a: Old-growth forest summary. The gully contained old growth Mountain Grey Gum damp riparian forest (3.1). This was flanked by a narrow strip of old growth Mountain Ash wet forest (2.1). These habitats contained a dense middle storey layer of Hazel Pomaderris, Blanket-leaf and Banyalla, thickets of tall Blackwood, Silver Wattle and Mountain Hickory Wattle, a gallery of Rough and Soft Tree-ferns and an open field layer of rosette ferns (e.g. Mother Shield-fern), Sword Tussock-grass and Red-fruit Saw-sedge.

96^a: A third fewer bird species on the logging coupe. Thirty species of native birds were recorded on the coupe and 46 were recorded in the gully. With the exception of the Blue-winged Parrot, Flame Robin, Rufous Whistler, Black-faced Cuckoo-shrike, Red-browed Firetail, Grey Currawong and Australian Magpie, all species seen on the coupe were recorded in the gully. The magpie and robin were utilising the open space adjacent to a recently cleared coupe.

Several gully species inhabited the shrub layers of the coupe including the Superb Lyrebird, Brown-headed Honeyeater, Olive Whistler, Pilotbird and Eastern Whipbird, each of which were breeding. Some gully species such as the Crimson Rosella and Crescent Honeyeater inhabited the coupe in higher densities, the ground disturbance and fire from logging operations having created early successional food-plants (e.g. Forest Wire-grass and fireweeds for the parrots). The relatively high bird diversity on the coupe is largely due to the retention of the old growth forest along nearby Falls Creek.

96^a: Old-growth bird species not recorded in the logging coupe, particularly tree hollow specialists and insectivores. Twenty species were seen in the gully forest and not on the coupe. The notable difference between the two faunas was the paucity on the coupe of tree hollow species (1), tree canopy or upper trunk and branch species (2) and species requiring a combination of open field layers and heavy litter under a gallery of mature tall shrubs or ferns (3).

These included the Brush Bronzewing (3), Wedge-tailed Eagle (2), Southern Boobook (1), Gang-gang Cockatoo (1, 2 and 3), Sulphur-crested Cockatoo (1 and 2), Shining Bronze-Cuckoo (2), Brush Cuckoo (2 and 3), Tree Martin (1 and 2), Satin Flycatcher (2), Rufous Fantail (3), Pink Robin (3), Rose Robin (2 and 3), Large-billed Scrubwren (3), Red-browed Treecreeper (1 and 2), White-throated Treecreeper (1 and 2), Mistletoebird (2), Striated Pardalote (1 and 2), Red Wattlebird (2), Varied Sittella (2), Satin Bowerbird (3), Bassian Thrush (3) and Australian Raven (2).

96^a: Absence of larger owls from the site. Neither the Powerful Owl nor the Sooty Owl, which inhabit old growth forests of the Plenty River headwaters to the east, were located (playback calls were employed).

96^a: Shrub layer birds dominant in both faunas. Shrub layer birds were numerically dominant in both faunas. Most abundant species in both the gully and the coupe were the Grey Fantail, Golden Whistler, White-browed Scrubwren and Brown Thornbill. Tree canopy species including the Striated Thornbill, Spotted Pardalote and White-naped Honeyeater were the next most abundant in the gully while species of more open shrublands including the Superb Fairy-wren, Eastern Yellow Robin and Eastern Spinebill were the next most common on the coupe. Flowering Mountain Correa on the coupe had attracted the Crescent and White-naped Honeyeaters.

Mammals

96^a: Hollow dependent arboreal mammals in the old-growth forest. A further comparison of tree hollow species inhabiting the gully and the regrowth coupe was made by spotlighting. The gully contained the Greater Glider, Sugar Glider and Mountain Brushtail Possum. The coupe had none of these. It only supported the Common Ringtail Possum (builds leaf/bark nests). The gully also contained the five characteristic mountain forest bats of NEM (Chocolate Wattled Bat, Southern Forest Bat, Gould's Long-eared Bat, Eastern False Pipistrelle and White-striped Freetail Bat). These were caught in a bat trap placed along a logging track. When released the following morning, they returned to hollows in the gully Mountain Grey Gums. The bats foraged over the coupe and along the logging tracks.

96^a: Ground mammals. The Swainson's Antechinus and Bush Rat were trapped under old growth forest in the gully. Both species likely inhabited the regrowth coupe. Rabbits were present along the logging tracks.

Reptiles

96^a: Recolonisation of logging coupe by generalist reptiles. Several ash forest species remained in or had recolonised the regrowth coupe. These included Coventry's Skink, Southern Water Skink, McCoy's Skink, White-lipped Snake and Lowland Copperhead. The Spencer's Skink and Southern Grass Skink had not recolonised and were confined to the gullies. The Spencer's Skink inhabits senescing Silver Wattles. The Garden Skink, which was common on nearby exposed slopes, was dominant in the recently logged coupe.

MANAGEMENT

Threatening Processes	Conservation Measures
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Regional Habitat Link Strategy

Habitat connectivity. Intact habitat links to sites 95 and 103.

Hardwood production in upland areas and loss of tree hollow fauna. Most tree hollow dependent faunal species were absent from a logging regrowth coupe along Hilliers Road or at least only visited it from the adjacent unlogged forest gullies (e.g. Gang-gang Cockatoo, Australian Owllet-nightjar, Laughing Kookaburra, Mountain Brushtail Possum and Greater Glider). Other species which are sensitive to rapid successional changes of the understorey were also absent from the coupe (e.g. Brush Bronzewing, Rose Robin, Bassian Thrush, Large-billed Scrubwren, Red-browed Treecreeper, Satin Flycatcher, Red-browed Treecreeper, Satin Bowerbird, Spencer's Skink and Southern Grass Skink).

Retain hollow trees in logging coupes. The requirements of hollow nesting species must be considered in long-term forest management. Large trees supporting hollows are retained on logging coupes, but harvesting activities (e.g. spread of soil pathogens by earthworks, incineration to promote seedling establishment, exposure to wind) cause a noticeable decline in their vigour. The management and conservation of species such as the Sooty Owl, Yellow-bellied Glider and Spencer's Skink in NEM will require strict adherence to these plans and controls and the protection of nesting and feeding habitat and habitat links.

Absence of large tree hollow dependent species from logging coupes. Large hollow nesting species which require at least 150 or more years for suitable hollows to develop were absent from the entire site (e.g. Powerful Owl, Sooty Owl, Yellow-tailed Black-Cockatoo, Australian King-Parrot and Yellow-bellied Glider). Their requirement of extensive areas of old growth forest to provide dependable food or cover availability makes them vulnerable to logging, particularly clearfelling operations (see volume 1).

Silvicultural practices lower the forest fauna species diversity. In the Mt Disappointment State Forest, selective silvicultural practices have been conducted over the last 30 years to raise sawlog production. These include the removal of less desirable tree species (e.g. Narrow-leaf Peppermint) or mature stags or direct seeding of desirable timber trees (e.g. Mountain Ash and Messmate).

This has created even-age single-species stands. These contain a low diversity of large tree hollow-dependent species due to a reduced number of home sites (Golding 1979). These species form prey for top-level carnivores such as the Sooty and Powerful Owls. The removal of old-growth forest links in Mount Disappointment State Forest has isolated populations of these animals to small, old growth stands. They have declined substantially or been eliminated through lack of recruitment.

Insect defoliation of young trees in adjacent silvicultural plantation of Alpine Ash. A 10-year-old silviculture plantation of Alpine Ash was also present. The Red-browed Treecreeper and Varied Sittella inhabited a section of the plantation adjacent to a stand of Mountain Ash that had been left at the head of a gully. Infestations of stick-insects were observed on the Alpine Ash, probably arising from the lack of canopy foliage insectivores present.

Code of Forest Practice—develop a mosaic of habitat successions in logging coupe rotation plan. Implementing provision within forest management plans and *The Code of Forest Practice* within the legislative framework of the *Timber Industry Strategy* may better conserve rare, old-growth wet forest habitat and fauna (particularly along streams) within logging areas. Logging coupes should be rotated in such a way that any given area contains a mosaic of coupes from 0 to 80 years (at least) and connects retained links of unlogged old growth forest along streams and gullies.

Formulate a system of effective wildlife corridors. A system of wildlife corridors should be devised for the Mt Disappointment State Forest given the biological significance of the adjacent Plenty River headwaters.

Regional Hydrological Strategy—Conservation Measures

Monitor adherence to prescription logging activities near streams. In the Central Highlands, logging prescriptions prohibit operations within 40 m of rivers and 20 m of perennial streams. They also make provision for additional reservations to protect rare species or habitats (e.g. rainforest) or link other reserves with wildlife corridors. Arising from this study, an extension of the width to 100 m along all streams in Mt Disappointment State Forest would be desirable.

Retain strips of stream and gully vegetation for wildlife corridors. Major gullies (containing tree-ferns and dense stands of Silver Wattle), particularly those that are steep and difficult to access or would undergo severe ground disturbance during logging, must be protected. These areas contain diverse populations of birds and are particularly important for many regionally depleted or restricted species including the Brush Bronzewing, Yellow-tailed Black-Cockatoo, Pink Robin and Bassian Thrush. Their retention enables these species to recolonise adjacent logging coupes. The main headwater gullies of Falls Creek and Plenty River West Branch are such examples.

Improve water quality/flow of feeders of the Plenty River.

HR B PLENTY RIVER HEADWATERS

This management unit consists of three sites of state faunal significance (sites 97, 98 and 99) and surrounding land that forms habitat links. The evaluation of this unit covers a range of threatening processes and management issues in depth and is referred to in other site evaluations where such processes and issues arise.

Map Reference: 7923 364505 to 7923 363566 (Plenty River East Branch).

Location/Size: Forested plateau and southern slopes of the Great Dividing Range containing the headwaters of the Plenty River East Branch and tributaries, Jack Creek, Joey Creek, Yellow Creek and Toorourrong Reservoir. Approximately 4200 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit occurs near the western end of the Eastern Uplands physiographic region of the Great Dividing Range.

Landforms

Mountain: plateau, spurs, ridges, slopes, valleys (strongly dissected), gullies and streams/ headwaters. Foothill: hill-crests, hill-slopes, valleys, gullies, streams and water impoundment (Toorourrong Reservoir). Elevation is 220–794 m (Mt Disappointment). This is the broadest topographic/climatic range for any unit in NEM. The plateau between the summit of Mt Disappointment and Cascades farm is the highest and wettest locality in NEM.

Hydrology

The streams rapidly descend the southern escarpment of the Great Dividing Range. In the upper reaches they contain granite or sedimentary waterfalls and cascades under a rainforest gallery. The top of the plateau lies between 500 m and 790 m elevation, is gently undulating and forms a central spur and several side spurs of the Great Dividing Range. The southern face of the plateau lies between 300 m and 500 m; it is strongly dissected and forms long ridges, steep mountain slopes and deep valleys. Ridges are separated by narrow saddles which form the headwaters of streams.

The main branches of the Plenty River are fast-flowing perennial mountain streams. Toorourrong Reservoir is a water impoundment of 20 ha, surrounded by meadows and scrub of about 5 ha. The maximum depth of the reservoir is about 7 m. The northern arms contain shallow water (0.5–1 m deep). Between 1 and 2 m of silt has developed on the floor of the reservoir and has built in places to form emergent mudbars. The Wallaby Creek aqueduct enters the eastern side of the reservoir via Jack Creek. The reservoir was commissioned in 1885. The headwaters of the Wallaby Creek which flow north into the Goulburn River have been diverted from a point on the dividing range via the Wallaby Creek Aqueduct into Toorourrong Reservoir. Over 80% of the flow in the Jack Creek is provided by the Wallaby Creek diversion.

Rainfall: 750–1300 mm (grading from south-west to north-east).

Site 97 Joey Creek

- Map Reference:** 7923 408515 (mid-point). One minute lat/long grids include 37° 27' x 145° 12' and 37° 28' x 145° 10' to 145° 13'.
- Location/Size:** Approximately 780 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: water catchment including the Joey Creek Reference Area (Melbourne Water).
- Landforms:** Mountain and foothill (see HR B). Elevation is 260–536 m (Smiths Hill).

Natural Heritage Values

Landscape. The Joey Creek Reference Area is proclaimed within the Victorian Reference Area System (see the Mount Disappointment–Plenty River Headwaters site). The reference area contains one of few unlogged damp sclerophyll forest systems in Victoria.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Broad-leaved Peppermint heathy forest (8.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Rare species: Creeping Grevillea

Critical assemblages or populations: Strategic Habitat Link. Wet Mountain Forest Ecological Reference Area

FAUNAL SIGNIFICANCE: Site 97 Joey Creek

Assessment: State—Category 3 (C, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

97^a: 37° 28' x 145° 11'; Joey Creek Reference Area—west sector

97^b: 37° 28' x 145° 12'; Joey Creek Reference Area—east sector

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

Regional. 97^b: Mountain Dragon. **97^a:** Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

State. 97^b: 8 species including the Gould's Long-eared Bat, Southern Forest Bat and Eastern False Pipistrelle trapped at Road 17 on 18/19 March 1988. A ninth species (White-striped Freetail Bat) was heard while spotlighting on 18 March 1988

i. Arboreal mammals

Regional. 97^b: 4 species including the Mountain Brushtail Possum and Greater Glider while spotlighting along Road 17 on 18 March 1988

k. Frogs

Local. 97^b: 4 species including the Victorian Smooth Froglet along Track 17 in a 3-hour herpetofauna search on 19 March 1988

I. Reptiles

State. 97^b: 11 species including the Mountain Dragon, White's Skink, Southern Grass Skink, McCoy's Skink, Coventry's Skink and White-lipped Snake along Track 17 in a 3-hour herpetofauna search on 19 March 1988

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 97^b: 50 species. **Local. 97^a:** 42 species

b. Native birds

Local. 97^a: 35 species (incomplete survey). **97^b:** 12 species (incomplete survey)

c. Native mammals

Regional. 97^b: 16 species. **Local. 97^a:** 5 species

d. Herpetofauna

Regional. 97^b: 14 species. **97^a:** 10 species

e. Freshwater fish

Local. 97^a: 1 species (Mountain Galaxias)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Local. 97^b: 9 species. **97^a:** 6 species

c. Regionally vulnerable fauna (R2 species)

Regional. 97^b: Mountain Dragon

d. Regionally rare fauna (R3 species)

Regional. 97^b: 7 species. **Mammals:** Mountain Brushtail Possum, Greater Glider, Gould's Long-eared Bat, Eastern False Pipistrelle. **Reptiles:** Coventry's Skink, Southern Grass Skink, White-lipped Snake

Regional. 97^a: 2 species. **Reptiles:** Coventry's Skink. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 97^a: 4 species: **Birds:** Superb Lyrebird, Eastern Whipbird. **Reptiles:** White's Skink. **Fish:** Mountain Galaxias

Local. 97^b: 1 species: **Reptiles:** White's Skink

f. Regionally restricted fauna (R5 species)

Local. 97^a: 4 species: **Birds:** Olive Whistler, Red-browed Treecreeper, Rose Robin. **Reptiles:** McCoy's Skink

Local. 97^b: 2 species: **Reptiles:** McCoy's Skink and Southern Toadlet

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 97^b: 8 Mountain Dragons during a 3-hour herpetofauna search along Road 17 on 19 March 1988. This is the highest recorded population density in GM

i. Bat trapping rate

Regional. 97^b: 49 bats over two nights (trap-night average of 25 bats) at Road 17 on 18/19 March 1988

m. Regionally rare fauna

Regional. 97^b: 6 Coventry's Skinks during a 3-hour herpetofauna search along Road 17 on 19 March 1988

Outlook

The faunal significance is being maintained by current management.

Fauna

Visited on only two occasions (18/19 March 1988 and 20 October 1988). Ground mammal trapping and bird survey were not conducted.

Rare or Threatened Fauna

Bc 97^b: Mountain Dragon (see *Fb*).

Bc 97^a: **Mountain Galaxias**. They inhabit the small pools of Jack Creek and Yellow Creek., upstream of the main population of their predator, the Brown Trout.

Critical Assemblages or Populations

Ch 97^b: **High bat diversity in old-growth forest of Joey Creek Reference Area**. A bat trap was placed for two nights on 18/19 March 1988 along Track 17 about 700 m from Track 16. It yielded 49 bats of 8 species. The trapping rate of almost 25 per night was one of the highest for NEM. This is attributable to the high density of hollows available in the old-growth forest.

Cl 97^b: **High reptile diversity—upper Joey Creek Reference Area census, March 1988**. Eleven species including the Mountain Dragon, White's Skink, Southern Grass Skink, McCoy's Skink, Coventry's Skink and White-lipped Snake were recorded along Road 17 in a 3-hour herpetofauna search on 19 March 1988. The Coventry's Skink (damp sclerophyll forest (on the sheltered side of the ridges; 4.1), Southern Water Skink and Garden Skink (heathy forest on the exposed side of the ridges; 8.1), were the most common species.

Fb 97^b: **Highest population density of Mountain Dragons in NEM**. Eight Mountain Dragons (and 11 other reptile species) were located in 3-hour herpetofauna searching along Road 17 on 19 March 1988. This was by far the largest number of these dragons seen at any location in NEM. They were recorded at 500 m elevation on the margin of Mountain Grey Gum damp sclerophyll forest (4.1) on the plateau and upper sheltered mountain slopes and Broad-leaved Peppermint heathy forest (8.1) on the spur line.

The ground contained ample litter, logs and rocks but was well-drained and relatively dry. The damp sclerophyll forest contained a mid-dense cover of Forest Wire-grass and Grey Tussock-grass and low to medium height shrubs (notably Common Heath, Prickly Bush-pea and Narrow-leaf Wattle). The dragon was not observed under the dense shrubland of damp sclerophyll forest on the wetter slopes or under the sparse shrub layers of the Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) at lower elevation on Road 17.

Mountain Dragons require the sunny opening provided by the track for basking, usually on rocks or logs. Since they inhabit cold climates, their basking and activity are restricted to sunny positions. They escape the cold winters by undergoing torpor in hollow logs and burrows deep under tree stumps and rock outcrops. They are equally adept on the ground or rock and log surfaces, or climbing shrubs and low-level trees. They pounce from logs and rocks for ants, spiders, flies and beetles, glean insect larvae from foliage and under litter and probe for termites under bark.

The female lays two moderate-sized soft-shelled eggs during November–December in a small incubation burrow excavated in loose, warm soil in sunny positions. Juveniles have been observed in early autumn.

Other Significant Fauna

Mammals

97^b: Mountain Brushtail Possum and Greater Glider. The hollows provided by the mature Messmates along the eastern end of Road 17 support substantial populations of both species.

MANAGEMENT

Habitat connectivity. Strategic Habitat Link to sites 98, 99 and 100.

See the Mount Disappointment–Plenty River Headwaters site.

Planning Recommendations

Joey Creek Reference Area (see MMBW 1987).

Wet Mountain Forest Ecological Reference Area.

Site 98 Mount Disappointment–Plenty River Headwaters

- Map Reference:** 7923 380513 (southern point); 7923 375575 (northern point); 7923 345535 (western point); 7923 412533 (eastern point); 7923 350560 (Mt Disappointment). One minute lat/long grids include 37° 24' x 145° 09', 37° 25' x 145° 08' to 145° 11', 37° 26' x 145° 07' to 145° 11' and 37° 27' x 145° 08' to 145° 11'.
- Location/Size:** Approximately 2300 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: water catchment including the Disappointment Reference Area (Melbourne Water). The hardwood production area of the south-eastern section of Mount Disappointment State Forest adjoins the site (NRE).

Landforms

Mountain and foothill (see HR B). Elevation is 240–794 m.

Natural Heritage Values

Landscape. The Disappointment Reference Area is proclaimed within the Victorian Reference Area System.

The reference area contains possibly the only unlogged wet forest and cool temperate rainforest systems in Victoria. The site was proclaimed as a protected water catchment in 1881. Management, particularly relating to issues of restricted access, little intervention from humans and protection from catchment timber harvesting and land settlement, has been highly favourable for the conservation of flora and fauna species.

Areas in the far north-west and north-east of the site were only selectively logged prior to 1881. The section west of Road 1 and south of Mt Disappointment is regrowth from extensive forest clearing and/or bushfires. This is now also protected forest and forms the western buffer between the Disappointment Reference Area and the hardwood production area of Mount Disappointment State Forest. Old growth forests are those that have been protected from logging and fire for 150 years or more (Ashton in Groves 1981, David Milledge pers. comm.). Sections of the Disappointment Reference Area have been neither logged nor burnt since settlement and are the only such areas in GM and some of the few in Victoria. The site has the most intact examples of old growth Southern Sassafras cool temperate rainforest (1.1) and Mountain Ash wet forest (2.1) in GM. It has high biogeographical significance for flora and fauna and provides rare natural occurrences and disjunct range limits of species.

The central highlands ash forest and cool temperate rainforest are at their western range limit, the latter being at its ecological and distributional limits (Cheal *et. al* in prep.). The rainforest occurs along streams and gullies of the Plenty River East Branch tributaries in the Disappointment Reference Area where annual rainfall and elevation exceed 1100 mm and 550 m respectively. There is a 'relict' stand of Myrtle Beech on the main tributary below Road 14. The successional transition from ash forest to rainforest in the beech gully is of great scientific importance.

The old growth ash forest and rainforest are some of few unmodified pre-European stands of vegetation in Victoria. Some stands on the southern escarpment of Mt Disappointment originate from fires dating about 1730 (MMBW 1987). These escaped large post-European settlement bushfires in 1851, 1898, 1926 and 1939. A stand of 530 ha of the 1730 old growth ash forest has an average of 40 trees/ha occurs in the reference area (MMBW 1987). The veteran ash stags (about 265 years old) have a diameter at breast height of up to 6 m and some approach 85 m tall despite partial crown loss to lightning strikes and wind. There is a further 235 ha originating from 1851. The advance of timber cutters and paling splitters from Wandong had not extended beyond the plateau onto the southern escarpment by 1881 when harvesting was excluded.

The old growth ash forest at Mt Disappointment is dominated by trees that have reached maximum size and the ground contains many fallen branches and tree trunks. The understorey is luxuriant and consists of a multi-strata of broad-leaved shrubs and tree-ferns. The open canopy of the veteran ash trees has enabled a dense grassy field layer to develop under forest openings. Areas burnt in the major fire of 1926 have an understorey dominated by Hazel Pomaderris, which has replaced the Silver Wattle. Double burn areas (both 1926 and 1939) are dominated by Silver Wattle. The pomaderris is senescing in areas burnt in 1898. Long unburnt areas (last burnt in 1851 or earlier) contain fewer shrubs and a dominant rosette fern (e.g. Mother Shield-fern) and Sword Tussock-grass and Giant Mountain Grass understorey.

Scientific and Educational Values

Scientific reference. Electrofishing sites and instream reference points in the Wallaby Creek at Track 12 and Plenty River East Branch Headwaters at Track 14.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Southern Sassafras–Myrtle Beech cool temperate rainforest (1.1); Mountain Ash wet forest (2.1); Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Mealy Stringybark heathy woodland (9.1); Messmate–Swamp Gum gully woodland (10.2)

Partially intact or small stands: Broad-leaved Peppermint heathy forest (8.1); Long-leaf Box - Red Stringybark box–stringybark woodland (11.4)

Vulnerable species: Austral Moonwort and Fairy Lanterns

Rare species: Netted Brake, Slender Tree-fern, Bristly Shield-fern, Forest Sedge, Creeping Grevillea and Tree Geebung

Critical assemblages or populations: Strategic Habitat Link. Wet Mountain Forest Ecological Reference Area: the most significant stands of rainforest/wet forest in GM; 8 VROT species and another dozen regionally endangered and disjunct rainforest species. These include the Weeping Spleenwort, Austral Ground-fern, Narrow Filmy-fern, Rock Felt-fern, Small Fork-fern, Butterfly Orchid, Notched Phebalium and Gunyang. The Weeping Spleenwort, Narrow Filmy-fern and Bristly Shield-fern are referred to as ‘antarctic’ ferns. These are restricted to cool temperate mountain rainforest of Myrtle Beech and Southern Sassafras in southern Victoria and Tasmania and have related forms in New Zealand and South America. They arose in Gondwana, the supercontinent annexing Australia to Antarctica and South America over 100 million years ago.

Rainforest was more extensive in the Central Highlands in the humid post-glacial warming phase of the late Pleistocene Epoch (from 14 000–7000 years ago). A more arid climate has since contracted the cool temperate rainforest to relictual stands. Mt Disappointment Reference Area contains stands that are undisturbed by humans (e.g. bushfires and logging). These are of very high biogeographic importance for disjunct rainforest insect fauna. The waterfall and peat bog pools of the Plenty River East Branch contain semi-aquatic species with an ancestry in Gondwana. These include flies (blepharicerids and midges), mayflies, stoneflies and caddis flies.

FAUNAL SIGNIFICANCE: Site 98 Mount Disappointment–Plenty River Headwaters

Assessment: State—Category 1 (B, C, D, E, F); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

98^a: 37° 25' x 145° 08'; Mt Disappointment summit

98^b: 37° 25' x 145° 09'; Plenty River headwaters and Tracks 1/3

98^c: 37° 26' x 145° 09'; Plenty River East Branch at Track 14

98^d: 37° 27' x 145° 08'; Plenty River East Branch, Tracks 2/54

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 98^c: Sooty Owl and Powerful Owl (both breeding), Yellow-spot Jewel butterfly

Regional. 98^d: Mountain Dragon

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

State. 98^b: 9 species including the Eastern False Pipistrelle and Gould's Long-eared Bat trapped at a dam along Track 1 near Track 3 from 24 to 27 January 1988

State. 98^a: 8 species including the Eastern False Pipistrelle and Gould's Long-eared Bat trapped at Mt Disappointment summit from 24 to 27 January 1988

i. Arboreal mammals

State. 98^c: 7 species including the Mountain Brushtail Possum, Greater Glider, Yellow-bellied Glider, Feathertail Glider and Eastern Pygmy-possum at Track 14 near Plenty River East Branch on 25 March 1988

j. Ground mammals

Regional. 98^c: 7 species including the Dusky Antechinus, Long-nosed Bandicoot and Swamp Rat at East Branch on Track 14 in late October 1990

l. Reptiles

State. 98^a: 11 species including the Black Rock Skink, White's Skink, McCoy's Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink, Eastern Three-lined Skink, Lowland Copperhead and Tiger Snake at the summit of Mt Disappointment in a 3-hour census on 27 March 1988

Regional. 98^c: 9 species including the Black Rock Skink, White's Skink, McCoy's Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink and Eastern Three-lined Skink at East Branch on Track 14 between 29 and 31 October 1990

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 98^c: 98 species. **98^d**: 76 species

b. Native birds

Regional. 98^c: 59 species. **98^d**: 50 species

c. Native mammals

State. 98^c: 24 species. **Regional. 98^d**: 9 species

d. Herpetofauna

Regional. 98^d: 17 species. **98^c**: 15 species. **98^a**: 11 species

f. Butterflies

Regional. 98^d: 25 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 98^c: 33 species

Regional. 98^d: 20 species

b. Regionally endangered fauna (R1 species)

Regional. 98^c: 2 species. **Birds:** Sooty Owl, Black-faced Monarch

c. Regionally vulnerable fauna (R2 species)

State. 98^c: 8 species. **Birds:** Lewin's Honeyeater, Satin Bowerbird. **Mammals:** Long-nosed Bandicoot, Eastern Pygmy-possum, Yellow-bellied Glider. **Butterflies:** Mountain Spotted Skipper, Anderson's Skipper, Victorian Hair-streak

Regional. 98^d: 4 species. **Birds:** White-throated Nightjar, Blue-winged Parrot, Cicadabird. **Reptiles:** Mountain Dragon

Regional. 98^a: **Butterflies:** Mountain Skipper; only record in NEM (Mt Disappointment summit)

d. Regionally rare fauna (R3 species)

State. 98^c: 16 species. **Birds:** Pilotbird, Pink Robin, Large-billed Scrubwren. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Feathertail Glider, Greater Glider, Eastern False Pipistrelle, Gould's Long-eared Bat. **Reptiles:** Black Rock Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink. **Butterflies:** Macleay's Swallowtail, Kershaw's Brown, Yellow-spot Jewel

State. 98^a: 9 species. **Mammals:** Dusky Antechinus, Eastern False Pipistrelle, Gould's Long-eared Bat. **Reptiles:** Black Rock Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink. **Butterflies:** Kershaw's Brown, Common Silver Xenica

State. 98^d: 9 species. **Birds:** Spotted Quail-thrush, Large-billed Scrubwren, Pilotbird. **Mammals:** Dusky Antechinus, Greater Glider. **Reptiles:** Marbled Gecko, Eastern Small-eyed Snake, White-lipped Snake. **Frogs:** Plains Froglet

e. Regionally depleted fauna (R4 species)

Regional. 98^c: 7 species. **Birds:** Powerful Owl, Australian King-Parrot, Superb Lyrebird, Bassian Thrush, Eastern Whipbird. **Mammals:** Swamp Rat. **Reptiles:** White's Skink

Regional. 98^d: 6 species. **Birds:** Superb Lyrebird, Eastern Whipbird. **Mammals:** Swamp Rat. **Reptiles:** White's Skink. **Butterflies:** Flame Skipper, Spotted Brown

Local. 98^a: 1 species. **Reptiles:** White's Skink

f. Regionally restricted fauna (R5 species)

Regional. 98^d: 12 species. **Birds:** Painted Button-quail, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Dark Purple Azure

Local. 98^c: 6 species. **Birds:** Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper. **Reptiles:** McCoy's Skink

Local. 98^a: 1 species. **Reptiles:** McCoy's Skink

g. Nesting birds of prey/parrots

Regional. 98^c: Powerful Owl, Sooty Owl and Australian King-Parrot

F. POPULATION DENSITY: Viability and Abundance—point census

i. Bat trapping rate

State. 98^b: Single trapping of 74 bats and trap-night average of 36 bats along Track 1 near Track 3 from 24 to 27 January 1988

m. Regionally rare fauna

Regional. 98^c: 20 Large-billed Scrubwrens, 18 Dusky Antechinus from 30 trap-nights (60% trapping rate), 5 Gould's Long-eared Bats and 10 Coventry's Skinks at Plenty River East Branch/Track 14 between 25 and 27 March 1988

Regional. 98^b: 6 Gould's Long-eared Bats and 7 Eastern False Pipistrelles near Intersection of Tracks 1 and 3 between 25 and 27 March 1988

Outlook

The faunal significance is being maintained by current management.

FAUNA

Rare or Threatened Fauna

Bc 98^c: Breeding Sooty Owl and Powerful Owl in the old growth wet forest. A pair of Sooty Owls responded to a playback tape in October 1990 on Track 14 at the main tributary of the Plenty River East Branch. A nest site was located in a large hollow of a Mountain Ash (wet forest; 2.1) stag above the East Branch. The floor of the rainforest along the East Branch had the highest trapping rates (60%) in NEM of the Dusky Antechinus, an important food item of the Sooty Owl. Powerful Owls breed in a Mountain Grey Gum among Southern Sassafras cool temperate rainforest (1.1) along a smaller branch of the Plenty River nearer Track 2. They are provided by the abundant arboreal mammal population in the area. A pair with two young was seen on 13 January 1988. This pair may be the same birds observed in late summer–autumn in lowland River Red Gum woodland at Fenwick Stud (site 15).

Critical Assemblages or Populations

Ch/Fi 98^b: High bat diversity and population density. On 27 March 1988, after a day of very high temperature, 74 individuals of nine species including seven Eastern False Pipistrelles were taken in one trap amongst old growth Mountain Ash wet forest (2.1). The trap-night average over three nights was 36 bats. This was the highest recorded in NEM and second highest (to Radar Hill at Melbourne Airport in WM) recorded in GM. The trap was set at 740 m elevation at a fire dam along Track 1, 200 m south-west of Track 3 (approximately 3 km north-east of Mount Disappointment).

Ci 98^c: High arboreal mammal diversity in the old growth wet forest/cool temperate rainforest. Seven species of arboreal mammals including the Mountain Brushtail Possum, Greater Glider, Yellow-bellied Glider, Feathertail Glider and Eastern Pygmy-possum were recorded on 25 March 1988 while spotlighting along Track 14 at the Plenty River East Branch. The Eastern Pygmy-possum and Feathertail Glider were seen in Southern Sassafras cool temperate rainforest (1.1) along the Plenty River. The enormous Mountain Ash support the highest population densities of hollow dependent fauna such as the Greater Glider and Mountain Brushtail Possum recorded in NEM.

Cl 98^a: High reptile diversity Mt Disappointment summit census, March 1988. The summit had been previously surveyed by Mark Hutchinson and Peter Robertson between 1978 and 1980. They collectively recorded 13 species. Those not recorded in the March 1988 census included the Tree Dragon and Eastern Brown Snake. The site 98 reptile assemblage of 18 species is the third-most diverse in GM (after Yarrambat and Janefield in the Plenty Gorge).

The area surrounding the summit supports Mountain Ash wet forest (2.1) with dense tall shrub and field layers. The ash has been cleared from the summit and the main canopy is provided by Blackwood and Victorian Christmas-bush. Immediately below the summit lies an open area of granitic boulders where the dominant vegetation is tussock grassland (Sword Tussock-grass, Giant Mountain Grass and Forest Wire-grass). Eleven species with a collective total of 40 individuals were recorded from a 3-hour census on 25 March 1988.

Significant species of the boulder area included the Black Rock Skink, White's Skink, McCoy's Skink, Spencer's Skink, Southern Grass Skink, Eastern Three-lined Skink and Lowland Copperhead. The most common species were the Southern Water Skink, Weasel Skink and Southern Grass Skink. The Black Rock Skink is uncommon in wet forest apart from rocky openings. The arboreal Spencer's Skink was located in an old Blackwood. This species has declined in logged wet forests over sections of its range (Peter Robertson pers. comm.). A Tiger Snake road-kill was seen on Track 1/Board Road 100 m north of the summit.

Other Significant Fauna

Birds

- Eb* **98^C: Black-faced Monarch near Track 14.** Two were seen foraging for insects in the canopy branches and foliage of Southern Sassafras and Silver Wattles on 25 March 1988. This is the only occurrence for the species in NEM.
- Ec* **98^C: Lewin's Honeyeater, Satin Bowerbird and other rainforest birds near Track 14.** A male Satin Bowerbird (only six other occurrences in NEM) was seen at a bower near the Pilotbird's nest. Large-billed Scrubwrens were very common. The Pink Robin and Lewin's Honeyeater (one of only four occurrences) were recorded nesting in late October 1990.
- Ec* **98^d: Cicadabird.** They are largely associated with Messmate damp sclerophyll/herb-rich foothill forests (4.2 and 6.3) in NEM. The forests of Mt Disappointment form the extreme western edge of their range in south-eastern Australia. On 26 March 1988 a juvenile was seen in the Messmates by a creek on Track 54, 400 m west of Track 2. The species was likely to have nested locally.
- Ec* **98^d: Blue-winged Parrot, White-throated Nightjar and other dry foothill birds of Track 54.** The Painted Button-quail, White-throated Nightjar and Spotted Quail-thrush are ground-dwelling species. They were recorded in the bare ground and open tussock grassland of Silvertop Wallaby-grass and Grey Tussock-grass under the Long-leaf Box-Red Stringybark box-stringybark woodland (11.4) along Track 54. A pair of Blue-winged Parrots nested in December 1986 in a Mealy Stringybark (heathy woodland) near the intersection of Track 54 and Track 2.
- Ee* **98^C: Nesting stronghold of the Superb Lyrebird and other rainforest birds near Track 14.** Three nesting female Superb Lyrebirds were present under the rainforest gallery on 30 October 1990. Their nests were bulky domes of sticks, fern-fronds and moss. One was lodged in a tree-fern, one on a granite rock ledge and one in a branch-fork of a huge fallen tree trunk. The dome-nest of the Pilotbird, composed of leaves, bark and twigs, was located in the low fernery. Pilotbirds forage mainly in the leaf litter scratchings of lyrebirds.

The Superb Lyrebird, Large-billed Scrubwren, Eastern Whipbird and Pilotbird are widespread in the adjoining wet forest (2.1). The site forms the stronghold for most (particularly the Superb Lyrebird) in NEM. Many of these species are at their western range limits along the Great Dividing Range.

- Ee* **98^C: Australian King-Parrot and other old-growth wet forest birds.** The old-growth stands of ash and riparian damp sclerophyll forests in the Disappointment Reference Area support high densities of old stag-trees. These contain numerous, large trunk hollows and relatively high population densities of hollow dependent fauna such as the Yellow-tailed Black-Cockatoo, Gang-gang Cockatoo and Australian King-Parrot.

Tree hollow studies conducted on wet forest birds and mammals in the Stony Creek Reference Area north of the Disappointment Reference Area determined that 39% of species used large tree hollows and 24% of species were dependent on tree hollows (Graeme Ambrose pers. comm.). Common species in the old-growth forest such as the Sulphur-crested Cockatoo, Laughing Kookaburra, Tree Martin, Varied Sittella, Crested Shrike-tit, Brown-headed Honeyeater, Red-browed Treecreeper, Striated Pardalote and Mistletoebird are uncommon in Mountain Ash forest elsewhere in NEM.

Large populations of shrub layer birds in the 1926 fire regrowth areas. The fire regrowth ash forests (2.1) north of Track 3 are dominated by Hazel Pomaderris. These contain high populations of Fan-tailed Cuckoos, Olive Whistlers, Yellow-faced Honeyeaters and Large-billed Scrubwrens.

Mammals

Ec **98^c: Long-nosed Bandicoot.** One animal was trapped above Track 14 by the Plenty River East Branch, on 29 October 1990. This was one of only five locations in NEM where the Long-nosed Bandicoot was trapped.

Ec **98^c: Yellow-bellied Glider.** They were reportedly common in the Hume Ranges in the 1930s (David Fleay pers. comm.) but are now very rare. Several nights were expended over the site playing the species call through a walkman and megaphone for the return of only one animal. A response was summoned on 27 March 1988 from the south end of a track which runs off Track 14 west of the Plenty River East Branch. The animal was some distance below (probably in the Mountain Grey Gum at around 500 m elevation). Several scarred Mountain Grey Gum 'feed trees' were observed at this elevation on Track 2 about 1 km south of Track 14. Extensive stands of mixed species old growth Messmate and Mountain Grey Gum damp sclerophyll forest (4.1 and 4.2) are present in the inaccessible section of the reference area surrounded by Tracks 52 and 14 and Tracks 3 and 2. These stands are favoured by the glider elsewhere in the Central Highlands, east of Toolangi. The species is normally rare in single species Mountain Ash forest (2.1) such as along Track 14.

Reptiles

Ed **98^d: Marbled Gecko, Coventry's Skink and other reptiles of the middle and lower altitude sections of Track 52.** Middle altitude Messmate–Narrow-leaf Peppermint (4.2) and Mountain Grey Gum damp sclerophyll forests (4.1) of the sheltered mountain slopes and gullies support relatively dense shrub and grass layers. The Marbled Gecko (at a granitic outcrop), Mountain Dragon, White's Skink, Weasel Skink, McCoy's Skink and White-lipped Snake were recorded in these habitats. The drier Broad-leaved Peppermint heathy forest (8.1) supports a denser low shrub layer. The Coventry's Skink and Blotched Blue-tongued Lizard were recorded in this habitat. The lower altitude exposed hill-slopes support Long-leaf Box–Red Stringybark box–stringybark woodland. This contains relatively open ground and shrub layers. The Tree Dragon, Garden Skink and Eastern Small-eyed Snake were recorded in this habitat.

Elimination of the Tree Goanna. The apparent absence of the Tree Goanna from the Plenty River headwaters may be the result of logging, clearing and fragmentation of linking foothill forests on private land on the southern face of the ranges. The species is present in dry foothill forests of Kinglake National Park, east of Masons Falls.

Frogs

98^b: Fire dams along Track 1/Board Road support several species of frogs including the Victorian Smooth Froglet and Striped Marsh Frog.

Freshwater fish

Electrofishing Survey: Wallaby Creek at Track 12

Map reference. 7923 399567. **Altitude.** 675 m. **Survey date.** 13 December 1988.

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Cool temperate rainforest (1.1). Herbs: Fishbone Water-fern, Hard Water-fern, Tall Tussock-grass, Tall Sedge and Smooth Nettle (50% cover; excellent condition). No alien species.

Frontage. Wet forest (2.1). Herbs: ferns and Sword Tussock-grass, Tasman Flax-lily and Tall Sedge (30% cover; excellent condition). No alien species.

Physical Features:

Pools

Substrate. Gravel, sand, cobbles and logs on sheet granodiorite; undercut banks.

Maximum size (mid-summer). 5.0 m wide by 0.6 m deep by 10 m long.

Riffles

Substrate. Gravel, sand, cobbles on sheet granodiorite.

Flow (mid-summer normal): **Size.** 1.0 m wide by 5 cm deep. **Velocity.** 0.8 m/sec. **Rate.** 9.5 ML/day.

Water Quality:

Summer: Temperature. 11.2°C. Conductivity. 40 ms. Turbidity. Clear.

Fish Recorded During Survey:

Native species numbers/status. Nil.

Alien species numbers/status. Nil.

98^C: Electrofishing Survey: East Branch Headwaters at Track 14

Map reference. 7923 376553. **Altitude.** 600 m. **Survey date.** 13 December 1988.

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Cool temperate rainforest (1.1). Wet forest (2.1). Herbs: Fishbone Water-fern, Hard Water-fern, Tall Tussock-grass, Tall Sedge and Smooth Nettle (50% cover; excellent condition). No alien species.

Frontage. Wet forest (2.1). Herbs: rosette ferns, Giant Mountain Grass, Tasman Flax-lily and Tall Sedge (30% cover; excellent condition). No alien species.

Physical Features:

Pools

Substrate. Gravel, sand, pebbles, cobbles and logs on sheet granodiorite; undercut banks.

Maximum size (mid-summer). 2.0 m wide by 0.5 m deep by 10 m long.

Riffles

Substrate. Gravel, sand and cobbles on sheet granodiorite.

Flow (mid-summer normal): **Size.** 1.0 m wide by 5 cm deep. **Velocity.** 0.8 m/sec. **Rate.** 9.5 ML/day.

Water Quality:

Summer: Temperature. 12.5° C. **Conductivity.** 50 ms. **Turbidity.** Clear.

Fish Recorded During Survey:

Native species numbers/status. Nil; the headwaters of the East Branch appear to be above the upper altitudinal limit of the Mountain Galaxias in the Plenty River system.

Alien species numbers/status. Nil.

Butterflies

98^d: Track 54 near Track 2. Twenty-five species were recorded. Significant species include:

- Donnysa Skipper, Spotted Skipper and Flame Skipper: breeding on Thatch Saw-sedge under Messmate herb-rich foothill forest (6.3) near a creek 400 m west of Track 2; adults recorded flying in December 1986
- Phigalia Skipper: adults seen along Track 54 in Mealy Stringybark heathy woodland (9.1) on 29 October 1990; larval food-plant is Wattle Mat-rush
- Spotted Brown and Bank's Brown: adults of both (former old and latter newly emerged) seen in creek flats 400 m west of Track 2 on 23 March 1988
- Dark Purple Azure: adult flying around Creeping Mistletoe (larval food-plant) under Messmate-Swamp Gum gully woodland (10.2) on 29 October 1990

98^c: Track 14 at Plenty River East Branch. The Olane Azure was seen amongst Drooping Mistletoe in the canopy of the Mountain Ash stags. Six regionally rare or threatened species were recorded. Each, with the exception of the swallowtail, was observed in Mountain Ash wet forest (2.1). These include:

- Anderson's Skipper: located under Mountain Ash/Hazel Pomaderris on Track 14, 200 m west of the East Branch in late January 1992; sightings elsewhere in NEM only in Kinglake NP

- Mountain Spotted Skipper: located near preceding feeding amongst flowering Forest Groundsel; likely breeding on Red-fruit Saw-sedge along the Plenty River; only two other sightings in NEM (Kinglake NP)
- Yellow-spot Jewel: adult located amongst Hazel Pomaderris (larval food-plant) near previous two species
- Victorian Hair-streak: breeding on stunted Silver Wattles along the edge of Track 14 near the East Branch; rarely recorded species of old growth forest with only two other sightings in NEM (Kinglake NP)
- Kershaw's Brown: 20–30 flying in the opening along Track 14 on 24 January 1992; likely breeding on Forest Wire-grass; locally common in the reference area
- Macleay's Swallowtail: several adults flying and late instar larvae feeding amongst Southern Sassafras cool temperate rainforest (1.1) along the East Branch at Track 14 and a minor tributary crossing Track 14 about 300 m east of Track 2 on 24 January 1992; single adult seen also on 23 March 1988

98^a: Mountain Skipper at Mt Disappointment summit. Several individuals were observed hill-topping the summit of Mt Disappointment on 24 January 1992. Adults were feeding amongst flowering Forest Groundsel and Derwent Speedwell. The granitic tors and surrounding shrublands form a mid-afternoon hill-topping/nectar-feeding area. This is the only known record of the species in NEM. Several fresh Kershaw's Brown and Common Silver Xenica were also seen at the summit. All three butterfly species possibly breed locally on Sword Tussock-grass or Giant Mountain Grass, which are both abundant amongst the granitic tors.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Strategic Habitat Link to sites 96, 97 and 99.	
	<p>Disappointment and Joey Creek Reference Areas. The Disappointment and Joey Creek Reference Areas are protected under the <i>Reference Areas Act 1978</i>. Since 1857, these areas have been part of Melbourne's water supply catchments via the Yan Yean system (MMBW 1987). The managing authority of these and surrounding buffer strips is Melbourne Water. Logging and other antagonistic human activities have been excluded since proclamation in 1881, the first such area in the state.</p>
Regional Hydrological Strategy	
	<p>Water catchment protection of rare and poorly reserved habitats. Protection of water supply catchments elsewhere in GM, involving restrictions on public access and timber extraction, has provided areas of high faunal conservation significance (e.g. Maroondah Reservoir catchment in UYR, see Mansergh <i>et al.</i> 1989). These areas support some of the most pristine examples of mature, undisturbed wet forest environments in Victoria. Apart from their intrinsic conservation value, these catchment areas provide important (sometimes unique and irreplaceable) scientific and environmental reference areas. The Disappointment Reference Area of the Toorourrong Reservoir catchment contains some of the most important examples of old-growth Mountain Ash forest and Southern Sassafras rainforest in Victoria. These plant communities are inadequately represented in the biological reserve system of Victoria.</p>
Other Issues	
<p>Bushfire. Bushfire is viewed as the major threat to the site. The scientific importance of the old growth ash forest and rainforest as intact 'relict' habitat for flora (including non-vascular species) and fauna (including invertebrate species) is considerable.</p>	<p>Maintain fire buffers. A slashed break 200 m wide along Board Road (Road 1) forms a fire buffer between the hardwood production area in the state forest to the north-west and the reference area.</p>
	<p>A full flora and invertebrate fauna survey needed. Vertebrate fauna research has been conducted in the reference area (e.g. Loyn 1985a; present study). Systematic flora and invertebrate research and monitoring would provide a sound basis for ecological management of the old growth ash forest and rainforest. The disjunct aquatic insects of the East Branch rainforest are of special scientific significance, warranting survey and research.</p>

Site 99 Toorourrong Reservoir

- Map Reference:** 7923 370510 (mid-point). One minute lat/long grids include 37° 28' x 145° 08' to 145° 09'.
- Location/Size:** Confluence impoundment of the Plenty River East Branch and Jack Creek and the lower reaches of both streams. Approximately 230 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: header storage for the Yan Yean system (Melbourne Water).
- Landforms:** Foothill (see HR B). Elevation is 210–300 m.

Natural Heritage Values

Landscape. A diverse biogeographical overlap of lowland and upland habitats.

Scientific and Educational Values

Scientific reference. Electrofishing sites and instream reference points in the Plenty River East Branch above Toorourrong Reservoir, at the south-east corner of the reservoir, Yellow Creek above Jack Creek, Jack Creek weir and in the East Branch downstream of the reservoir.

HABITAT SIGNIFICANCE

Assessment: High—Category 2

Reference stands: Manna Gum riparian forest (5.3); Messmate herb-rich foothill forest (6.3); Messmate–Swamp Gum gully woodland (10.2); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Sword Tussock-grass–Tall Sedge seasonal wetland (25.5); Common Reed–Cumbungi Tall Spike-sedge seasonal wetland (25.7)

Relatively intact or extensive stands: Blunt Pondweed–Lake Eel-grass permanent wetland (26.1)

Rare species: Showy Willow-herb, Creeping Grevillea

Critical assemblages or populations: diverse assemblage of reference stands. The reservoir fringe supports extensive populations of regionally threatened plants (e.g. Tassel Sedge, Australian Lilaeopsis and Purple Loosestrife). The nutrient-rich seasonal wetland of Plenty River inlet is the most important area for cover-dependent waterbirds in NEM while the Lake Eel-grass meadows of the reservoir support significant populations of waterfowl.

FAUNAL SIGNIFICANCE: Site 99 Toorourrong Reservoir

Assessment: State—Category 1 (B, C, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

99^a: 37° 28' x 145° 09'; Toorourrong Reservoir, Plenty River/Jack Creek

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 99^a: 12 species: Lewin's Rail (breeding), Baillon's Crake, Little Bittern (breeding), Australasian Bittern, Blue-billed Duck (breeding), Grey Goshawk (breeding), Barking Owl, Powerful Owl, Brush-tailed Phascogale, Glossy Grass Skink, Mountain Galaxias and Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

b. Waterbirds

Regional. 99^a: 21 species on 30 October 1990 and over 40 species from all visits

d. Breeding waterfowl

State. 99^a: 8 species including the Eurasian Coot, Blue-billed Duck, Hardhead, Grey Teal and Chestnut Teal on 4 November 1988

h. Bats

Unranked. 99^a: Traps were set during two field trips but no bats were taken on both occasions due to inclement weather

i. Arboreal mammals

Regional. 99^a: 7 species including the Greater Glider, Feathertail Glider and Brush-tailed Phascogale spotted along the lower Jack Creek and Plenty River on 16 December 1986

j. Ground mammals

Regional. 99^a: 5 species including the Brown Antechinus and Bush Rat at the Plenty River inlet on the north-east side of Toorourrong Reservoir on 20/21 October 1988

k. Frogs

Regional. 99^a: 8 species including the Growling Grass Frog, Victorian Smooth Froglet and Southern Toadlet on 16 December 1986

l. Reptiles

Regional. 99^a: 6 species including the McCoy's Skink, Delicate Skink and Lowland Copperhead at the Plenty River inlet on 20/21 October 1988

m. Freshwater fish

Regional. 99^a: 3 species downstream of the reservoir and 2 species in the shallows of the south-east corner of the reservoir on 12/13 December 1988 (see Fj)

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 99^a: 150 species

b. Native birds

State. 99^a: 116 species

c. Native mammals

Regional. 99^a: 16 species

d. Herpetofauna

Regional. 99^a: 18 species

e. Freshwater fish

Regional. 99^a: 5 species

f. Butterflies

Regional. 99^a: 30 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 99^a: 40 species

b. Regionally endangered fauna (R1 species)

Regional. 99^a: 1 species. **Birds:** Grey Goshawk

c. Regionally vulnerable fauna (R2 species)

State. 99^a: 12 species: **Birds:** Lewin's Rail, Baillon's Crake, Spotless Crake, Little Bittern, Australasian Bittern, Barking Owl, White-throated Nightjar, Azure Kingfisher. **Mammals:** Brush-tailed Phascogale. **Reptiles:** Glossy Grass Skink. **Fish:** Freshwater Blackfish. **Butterflies:** Bright Copper

d. Regionally rare fauna (R3 species)

State. 99^a: 14 species. **Birds:** Australian Spotted Crake, Great Crested Grebe, Darter, Australasian Shoveler, Pink-eared Duck, Hardhead, Blue-billed Duck, Musk Duck, Collared Sparrowhawk. **Mammals:** Mountain Brushtail Possum, Feathertail Glider, Greater Glider. **Frogs:** Plains Froglet. **Fish:** Common Galaxias

e. Regionally depleted fauna (R4 species)

State. 99^a: 13 species. **Birds:** Latham's Snipe, Swamp Harrier, Whistling Kite, Peregrine Falcon, Powerful Owl, Australian King-Parrot, Superb Lyrebird, Leaden Flycatcher. **Mammals:** Platypus. **Reptiles:** White's Skink. **Fish:** Mountain Galaxias, Southern Pigmy Perch. **Butterflies:** Spotted Brown

f. Regionally restricted fauna (R5 species)

Regional. 99^a: 13 species: Australian Pelican, Nankeen Night Heron, Australian Shelduck, Long-billed Corella, Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** McCoy's Skink, Delicate Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog. **Butterflies:** Phigalia Skipper, Bank's Brown, Sword-grass Brown

g. Nesting birds of prey/parrots

Regional. 99^a: Collared Sparrowhawk, Grey Goshawk, Whistling Kite and Australian King-Parrot

F. POPULATION DENSITY: Viability and Abundance—point census

a. International migratory birds

Regional. 99^a: 6 Latham's Snipe in the floodplain herbfield along the Plenty River arm of the reservoir on 30 October 1990

b. Rare or threatened fauna

State. 99^a: 15 Freshwater Blackfish electrofished (and another 15 seen) at Jack Creek weir; one of the highest recorded population densities in GM

c. Waterfowl

Regional. 99^a: 144 birds of 13 species at Toorourrong on 4 November 1988

j. Electrofishing rate

Regional. 99^a: 32 fish in the submerged herbfield at the south-east corner of Toorourrong Reservoir on 12 December 1988: 30 Southern Pigmy Perch and 2 Freshwater Blackfish. 32 fish from the Plenty River below Toorourrong Reservoir on 13 December 1988: 5 Short-finned Eel, 2 Mountain Galaxias and 25 Southern Pigmy Perch

m. Regionally rare fauna (R3 species)

Regional. 99^a: 10 Plains Froglets calling amongst Common Spike-sedge in the shallows of the south-east corner of Toorourrong Reservoir on 20 October 1988; 10 Hardheads and 6 Pink-eared Ducks at the reservoir on 4 November 1988; 5 Greater Gliders spotlit along the Plenty River and lower Jack Creek on 16 December 1986; a school of 20 Common Galaxias at the bridge near the mouth of Jack Creek on 12 December 1988

n. Regionally depleted fauna (R4 species)

Regional. 99^a: 3 Platypus and 30 Southern Pigmy Perch at Toorourrong Reservoir on 12 December 1988; 25 Southern Pigmy Perch in the Plenty River below Toorourrong Reservoir on 13 December 1988

o. Regionally restricted fauna

Regional. 99^a: 22 McCoy's Skinks from 120 minutes searching under logs on the sheltered hill-slopes under Messmate herb-rich foothill forest (6.3) at the north side of Toorourrong Reservoir on 20 October 1988

Outlook

The faunal significance is being maintained by current management.

FAUNA

Rare or Threatened Fauna

Bc 99^a: Breeding marsh birds—crakes, rails and bitterns. The Plenty River inlet at the north-eastern end of the reservoir is the finest breeding area in NEM for rare cover-dependent marsh birds. This is partly due to the area being isolated from human disturbance. A nutrient-rich silt delta has formed where the river enters the reservoir. Permanent wetland vegetation of Blunt Pondweed–Pacific Azolla submerged/floating herbfield (26.1) occurs in the open water. The mosaic of anabranches and islands support seasonal wetland vegetation. The mudflats of the reservoir and delta anabranches contain Common Reed emergent herbfield (25.7) while Sword Tussock-grass–Tall Sedge floodplain herbfield (25.5) occurs on the islands and river flats. These habitats support a diverse array of fish, frog and invertebrate life.

Rare species recorded breeding include the Lewin's Rail, Little Bittern, Baillon's Crake and Spotless Crake. These species are spring–summer migrants from northern Australia. The Plenty River inlet also supports other rare non-breeding visitors including the Australasian Bittern and Latham's Snipe. Marsh birds forage in the shallows, on mudflats and amongst emergent vegetation. Bitterns are predominantly nocturnal, the main feeding activity of Lewin's Rail occurs at dawn and dusk and crakes are active day and night. Bitterns take larger prey, particularly fish and frogs. Rails and crakes predominantly feed on smaller invertebrate prey such as insects, crustaceans and molluscs.

The Little Bittern was seen on 30 October 1990. The nest was placed over water close to the reservoir, formed by a suspended platform of Common Reed stems. Silt well over a metre deep (like quick-sand) restricts approach to a boat. Seen through binoculars from some distance, the nest contained several white eggs.

The Spotless Crake was seen on 30 October 1990. An adult was sitting on a saucer-shaped nest, placed over the water amongst a raft of dry leaves and stems of Common Reed and well-hidden by vegetation pulled together to form a canopy. The bird flushed to safety amongst dense reeds, leaving behind three light brown eggs on the nest.

The Baillon's Crake was seen on 30 October 1990. An open saucer-shaped nest of dry grass and sedge stems and containing five dark brown eggs, was placed above water amongst Common Reed on an anabranch.

The Lewin's Rail was seen on 20 October 1988. A nest with two newly hatched young and two cream eggs with brown-blotches was located in low vegetation close to the water's edge on one of the anabranch islands. The nest was a grass cup, placed on the ground amongst the stems of Common Spike-sedge.

Bc 99^a: Nesting Grey Goshawk and other birds of prey and parrots. On 30 October 1990 a pair of Grey Goshawk was seen with young in a stick-nest in a Manna Gum riparian forest (5.3) about 500 m upstream of the reservoir along Jack Creek. An active stick-nest of the Collared Sparrowhawk was located on 13 December 1988 in the dense canopy of a Manna Gum (5.3) on the East Branch upstream of the reservoir. On 30 October 1990, a pair of Whistling Kite also had a stick-nest along the Plenty River upstream of the reservoir. Nearby on lower Jack Creek, a pair of Australian King-Parrots bred in the trunk of a Manna Gum (5.3). Other significant birds of prey which may breed at Toorourrong included the Swamp Harrier and Barking Owl (Murray Dunne pers. comm.).

Bc **99^a: Glossy Grass Skink.** One was seen amongst Mountain Tea-tree in Common Reed emergent herbfield (25.7) between the Plenty River and Jack Creek on the east side of the reservoir. Populations of this species extend downstream along the Plenty River floodplain as far as Barbers Creek. The nearest populations occur along the Middle Yarra at Yering Backswamp and in the Lower Yarra near the mouth of Koonung Creek. They are threatened at both localities.

Critical Assemblages or Populations

Cd **99^a: High diversity of breeding waterfowl.** Eight species including the Eurasian Coot, Blue-billed Duck, Hardhead, Grey Teal and Chestnut Teal were breeding on 4 November 1988. A pair of Great Crested Grebe bred amongst Common Reeds (25.7) at the Plenty River inlet on 30 October 1990. The waterbody is second in importance in NEM only to Yan Yean Reservoir as habitat for waterfowl. Up to 200 including deep water species such as the Great Crested Grebe, Eurasian Coot, Australian Pelican, Australasian Shoveler, Musk Duck, Pink-eared Duck, Hardhead and Blue-billed Duck congregate on the reservoir. One hundred and forty-four birds of 13 species were present on 4 November 1988. The waterfowl roost on emergent mudbars and feed on invertebrates and aquatic vegetation amongst the Blunt Pondweed–Lake Eelgrass submerged/floating herbfield (26.1).

Fb **99^a: High population density of Freshwater Blackfish and Southern Pigmy Perch.** The Plenty River headwaters contain native fish fauna of high conservation significance (McKenzie 1989). These include the Freshwater Blackfish, Southern Pigmy Perch, Mountain Galaxias and Common Galaxias. The water quality and biological condition of the stream is high as it occurs in water catchment that is protected and unlogged (Reed & Newall 1988).

The most extensive population of Freshwater Blackfish recorded in NEM occurs in the Jack Creek. A substantial population of Southern Pigmy Perch was present amongst emergent herbfield (25.7) in the shallows of the south-eastern end of the reservoir. They were also common in the Plenty River immediately downstream of the reservoir. A school of 20 Common Galaxias was seen at the bridge near the mouth of the Jack Creek on 12 December 1988. This population of Common Galaxias, a species which normally migrates between the sea and freshwater to complete its life-cycle, is land-locked by the reservoir. It has been recorded in the Toorourrong–Yan Yean Aqueduct downstream of the reservoir (Closs 1984). Small numbers of Mountain Galaxias were recorded in Yellow Creek upstream of the reservoir and downstream along the East Branch. The low populations are largely due to the presence of predatory Brown Trout.

Other Significant Fauna

Birds

Cb **99^a: Waterbird utility of the reservoir.** Over 40 species of waterbirds have been recorded at Toorourrong Reservoir. Morang Wetlands of the northern Plenty Gorge supports the most diverse waterbird assemblage in NEM (over 50 species). The value of Toorourrong for waterbirds lies in its productivity of habitats, arising from the relatively long period over which they have developed. This provides the most stable, diverse and viable wetland ecosystem in NEM. Waterbirds interchange between Toorourrong and Yan Yean. These two permanent artificial wetlands are the key nodes for waterbirds moving around the freshwater wetland system of NEM, similar to the role of the settling lakes on the Werribee Sewage Farm (e.g. Lake Borrie) with the seasonal freshwater swamps on the Werribee Plains.

Ec **99^a: Darter and Azure Kingfisher.** The Darter and Azure Kingfisher were seen in dead standing Manna Gums (5.3) along the East Branch upstream of the reservoir. Brown Trout fingerlings are common in the reservoir and inlets and would be prey items for these birds.

Mammals

Ec **99^a: Feathertail and Greater Glider and other arboreal mammals.** The Manna Gums (5.3) of the Plenty River and Jack Creek support substantial and diverse populations of arboreal mammals. Five

Greater Gliders were seen on 16 December 1986. At 240 m, this was the lowest elevation in NEM at which the glider was recorded. The Mountain Brushtail Possum, Feathertail Glider and Brush-tailed Phascogale were also spotlighted on this occasion.

Ee **99^a: Platypus.** Two were seen at the Plenty River inlet at dusk on 24 March 1988. A further three were seen from a boat near the reservoir wall on 12 December 1988. The reservoir and its tributaries would support a population in excess of 10 animals. The Yarra Platypus Watches of 1995/96, conducted for Project Platypus, found this one of the most productive areas.

Reptiles

Ed **99^a: Plains Froglet and other reptiles and frogs.** Delicate Skinks are common in the unmown sections of Kangaroo Grass under the Yellow Box–Candlebark valley forest (31.1) near the reservoir picnic areas. Large populations of McCoy's Skinks inhabit the log-strewn areas of Manna Gum riparian forest (5.3) and Messmate herb-rich foothill forest (6.3) around the Plenty River arm and on the sheltered hill slopes of the reservoir. The Plains Froglet, Growling Grass Frog and Striped Marsh Frog occur in the emergent herbfields (25.7) around the reservoir and along the lower floodplain sections of the inlet streams. The White's Skink was trapped in the grass, sedge and tree-ferns of the Sword Tussock-grass–Tall Sedge floodplain herbfield (25.5) along the Plenty River just upstream of the reservoir.

Freshwater fish

99^a: Electrofishing Survey: East Branch above Toorourrong Reservoir

Map reference. 7923 368514. **Altitude.** 230 m. **Survey date.** 13 December 1988.

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Manna Gum riparian forest (5.3). Herbs: Fishbone Water-fern, Hard Water-fern, Sword Tussock-grass and Tall Sedge (50% cover; good condition). Floodplain herbfield (25.5; 5% cover; good condition). Alien herbs: Sweet Vernal-grass and Yorkshire Fog (20% cover).

Frontage. Messmate herb-rich foothill forest (6.3). Herbs: Forest Wire-grass, Austral Bracken and Spiny-headed Mat-rush (50% cover; good condition). Alien herbs: Yorkshire Fog and Sweet Vernal-grass (20% cover).

Physical Features:

Pools

Substrate. Sand, gravel and logs on sheet siltstone; undercut banks.

Maximum size (mid-summer). 3 m wide by 1 m deep by 20 m long. The river is predominantly composed of glides about 1 m deep.

Riffles

Substrate. Sand, gravel and logs on sheet siltstone.

Flow (mid-summer normal): Size. 2.0 m wide by 10 cm deep. **Velocity.** 0.6 m/sec. **Rate.** 28.6 ML/day.

Water Quality:

Summer: Temperature. 14.0°C. **Conductivity.** 63 ms. **Turbidity.** Clear.

Fish Recorded During Survey:

Native species numbers/status. Freshwater Blackfish (1); likely breeding resident.

Alien species numbers/status. Brown Trout (28); likely breeding resident.

99^a: Electrofishing Survey: Toorourrong Reservoir—south-east corner

Map reference. 7923 368506. **Altitude.** 220 m. **Survey date.** 12 December 1988.

Vegetation: Instream. Submerged meadow. Emergent herbfield (25.7). Floodplain herbfield (25.5)

Bank. Manna Gum riparian forest (5.3; 10% cover; fair condition with 30% cover native shrubs; good condition). Mixed native and alien herbs

Frontage. Yellow Gum–Candlebark valley forest (31.1). Mown understorey with 50% introduced grasses

Physical Features:**Pools****Substrate.** Reservoir shallows; silt.**Riffles and Flow:** N/A.**Water Quality:****Summer: Temperature.** 20.4°C. **Conductivity.** 60 ms. **Turbidity.** Clear.**Fish Recorded During Survey:****Native species numbers/status.** Southern Pigmy Perch (30); likely breeding resident. Freshwater Blackfish (2); likely breeding resident.**Alien species numbers/status.** Nil; Brown Trout were gill netted in the reservoir.99^a: Electrofishing Survey: Yellow Creek above Jack Creek**Map reference.** 7923 380513. **Altitude.** 240 m. **Survey date.** 13 December 1988.**Vegetation: Instream.** Submerged meadow. Floodplain herbfield (25.5) **Bank.** Manna Gum riparian forest (5.3; 20% cover native shrubs good condition, some weed invasion)**Frontage.** Messmate herb-rich foothill forest (6.3; 30% cover native shrubs good condition. Herbs: 50% cover; good condition. Some weed invasion).**Physical Features:****Pools****Substrate.** Cobbles, pebbles, gravel and sand on sheet siltstone.**Maximum size (mid-summer).** 2.0 m wide by 0.4 m deep by 5 m long.**Riffles****Substrate.** Cobbles, pebbles, gravel and sand on sheet siltstone.**Flow (mid-summer normal): Size.** 0.5 m wide by 2 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 0.95 ML/day.**Water Quality:****Summer: Temperature.** 17.5°C. **Conductivity.** 105 ms. **Turbidity.** Cloudy/Moderate.**Fish Recorded During Survey:****Native species numbers/status.** Mountain Galaxias (5); likely breeding resident.**Alien species numbers/status.** Brown Trout (2); likely breeding resident.99^a: Electrofishing Survey: Jack Creek weir**Map reference.** 7923 378512. **Altitude.** 250 m. **Survey date.** 13 December 1988.**Vegetation:** (same as site 3).**Physical Features:****Pools: Substrate.** Cobbles, boulders and gravel on sheet siltstone.**Maximum size (mid-summer).** 6.0 m wide by 1.0 m deep by 30 m long.**Riffles****Substrate.** Cobbles, pebbles and gravel on sheet siltstone.**Flow (mid-summer normal): size.** 2.0 m wide by 20 cm deep. **Velocity.** 0.8 m/sec. **Rate.** 75 ML/day.**Water Quality:****Summer: Temperature.** 16.0°C. **Conductivity.** 61 ms. **Turbidity.** Clear.**Fish Recorded During Survey:****Native species numbers/status.** Freshwater Blackfish (15 electrofished and 15 others seen); likely breeding resident.**Alien species numbers/status.** Brown Trout (16 electrofished and over 15 others seen); likely breeding resident.99^a: Electrofishing Survey: East Branch below Toorourrong Reservoir**Map reference.** 7922 364506. **Altitude.** 200 m. **Survey date.** 13 December 1988.**Vegetation:**

Instream. Submerged meadow (26.1; 20% cover of algae). Emergent herbfield (25.7).

Bank. Manna Gum riparian forest (5.3; 20% cover; fair condition). Floodplain herbfield (25.5). Herbs: Fishbone Water-fern, Hard Water-fern, Sword Tussock-grass and Tall Sedge (40% cover; good condition). Alien herbs: Sweet Vernal-grass and Yorkshire Fog (20% cover).

Frontage. Messmate herb-rich foothill forest (6.3). Also Yellow Box–Candlebark valley forest (31.1; 30% cover; good condition). Alien shrubs: Blackberry (10% cover). Herbs: Forest Wire-grass, Weeping Grass, Austral Bracken and Spiny-headed Mat-rush (30% cover; good condition). Alien herbs: Sweet Vernal-grass and Yorkshire Fog (20% cover).

Physical Features:

Pools

Substrate. Silt and logs on sheet siltstone.

Maximum size (mid-summer). 2.0 m wide by 0.5 m deep by 20 m long.

Riffles

Substrate. Sand, cobbles and logs on sheet siltstone.

Flow (mid-summer low): Size. Nil. **Velocity.** Nil. **Rate.** Nil. Flow starved by reservoir.

Water Quality:

Summer: Temperature. 18.0°C. **Conductivity.** 120 ms. **Turbidity.** High (darkly stained from eucalyptus lignin).

Fish Recorded During Survey:

Native species numbers/status. Short-finned Eel (5); migratory sub-adult. Mountain Galaxias (2); likely breeding resident. Southern Pigmy Perch (25); likely breeding resident.

Alien species numbers/status. Nil.

Butterflies

Df **99^a: Toorourrong Reservoir.** Thirty species recorded. Significant species: Donnysa Skipper, Flame Skipper, Spotted Skipper, Phigalia Skipper, Phigalioides Skipper, Symmopus Skipper, Common Dusky Blue, Common Imperial Blue, Cyril's Brown, Bank's Brown, Spotted Brown, Sword-grass Brown (breeding in Red-fruit Saw-sedge at the Plenty River inlet), Wood White and Imperial White.

MANAGEMENT

Habitat connectivity. Intact habitat links to sites 97 and 98

Threatening Processes	Conservation Measures
Regional Hydrological Strategy	
<p>Barriers to migratory movements of fish by the wall and spillway of Toorourrong. The return migration of the Common Galaxias is blocked. No migratory fish were recorded upstream of the reservoir (including the Short-finned Eel, lampreys and Broad-finned Galaxias, which can negotiate major instream barriers). The Toorourrong Reservoir on the upper Plenty River presents an apparently insurmountable barrier (McKenzie & O'Connor 1989). This may be due to a combination of the reservoir wall and lack of flow in the immediate downstream section of the Plenty River.</p> <p>Migratory movements of fish will remain blocked unless a fish-way is installed within the dam or weir wall infrastructure to provide continuity between upstream and downstream areas. The movement of species such as the Australian Grayling up the Yarra River was blocked by the weir at Dights Falls until the construction of a fish-way in 1994 (Tarmo Raadik pers. comm.). The weir had prevented or substantially restricted the entry of nine freshwater fish species (many of which are rare or threatened) into the waters of North East Melbourne. This is equal in number to the total freshwater fish fauna recorded for NEM during surveys between 1988 and 1992.</p>	<p>Feasibility study of a fish-way. The feasibility of a fish-way in the reservoir overflow to facilitate the migratory movements of fish should be ascertained. This may prove difficult in that the overflow appears to infrequently carry water. The design and efficiency of the fish-way would need to take into account the varying swimming capabilities and seasonal behaviour of fish species.</p>
<p>Brown Trout. This species occurs in large numbers in the reservoir and lower section of the Jack Creek and Plenty River East Branch. Populations of the native Common Galaxias and Mountain Galaxias are likely have been substantially reduced by the trout. The viability of populations of both species of galaxias upstream of the reservoir is threatened by the trout.</p>	<p>No further releases of Brown Trout into the reservoir or catchment streams should occur. The trout may be limiting all five native fish species present. Measures to reduce the trout populations should be investigated.</p>

Other Issues

<p>Raised top water level would inundate significant habitat. This would conflict with the primary biological values of Toorourrong Reservoir. Significant emergent herbfield, floodplain herbfield, riparian/swamp scrub and fern gully habitat along the Plenty River inlet and in the shallows on the south-eastern side of the reservoir would likely be eliminated.</p> <p>Deleterious effect of inundation on threatened marshland fauna. The emergent herbfields provide habitat for rare, cover-dependent waders (e.g. crakes, bitterns and Lewin's Rail) and the Glossy Grass Skink. Inundation and substantial loss of habitat would threaten the population viability of these species.</p> <p>Public access would disturb waterbirds. Opening up public access to the eastern shore of the reservoir would disturb waterbirds. This area provides secluded feeding and breeding habitat.</p>	<p>Environmental Impact Assessment should accompany any proposal to raise the top water level. If the top water level were to be raised the likely impact on the wetland fauna should be addressed in an environmental impact assessment.</p> <p>Given its faunal significance, access to the water and the eastern and northern sides of the reservoir should necessarily remain closed to the public.</p>
<p>Sambar Deer and Feral Pigs. Grazing, uprooting and browsing by both species was evident under the Mountain Tea-tree and in the herbfields.</p>	<p>Continuation of present water catchment management. Current management is protecting the flora and most fauna values of the site.</p>

HR C SCRUBBY CREEK HEADWATERS–SHERWIN RANGES

This management unit consists of one site of state faunal significance (site 100) and surrounding land that forms habitat links.

Map Reference: 7823 370480 to 7823 428492 (Shrubby Creek).

Location/Size: Between Humevale and the Sherwin Ranges north-east of Whittlesea, bounded by Yan Yean Catchment Track 1, Scrubby Creek Road, Whittlesea–Yea Road and Coombs Road and the extension of the Sherwin Ranges to the south. Approximately 1100 ha.

Municipality: City of Whittlesea.

Physical Features

The management unit occurs on the Kinglake Plateau of the Eastern Uplands.

Landforms

Mountain: plateau, spurs, ridges, slopes, valleys (strongly dissected), gullies and stream. Foothill: hill-crests, hill-slopes, valleys, gullies, stream and dams. Elevation is 160–538 m (Howat Lookout).

Hydrology

Scrubby Creek flows for eight or nine months of the year. The upper section flows south from the top of the Great Dividing Range at Kinglake West, the cascading stream having formed an incised valley as it descends from the ranges. At first it descends rapidly through a steeply incised mountain valley, then winds through a broad foothill valley and finally enters a floodplain before joining the Plenty River. The creek is fast-flowing in the upper and mid-reaches and contains, rock cascades and waterfalls. Pebble riffles, sand bars and undercut banks surrounding open water pools (<1 m deep) containing fallen tree trunks and exposed roots occur in the middle and lower sections. The creek channel through the lower section in the valley farmland is deeply scoured and the bank has undergone severe erosion.

Rainfall: 700–1000 mm.

Site 100 Scrubby Creek Humevale

- Map Reference:** 7923 388482 to 7923 418477; 7923 395481 (Parkers Road Reserve upstream of Humevale Road bridge on Scrubby Creek). One minute lat/long grids include 37° 29' x 145° 10' to 145° 12' and 37° 30' x 145° 10' to 145° 12'.
- Location/Size:** Scrubby Creek catchment upstream of Humevale. Approximately 960 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: Parkers Road Picnic Reserve (City of Whittlesea). Private: great majority. Livestock farms occur along the valley of Scrubby Creek, some 2–8 ha residential bushblocks at the downstream end, toward Humevale. Remainder of site is bushland.
- Landforms:** Mountain and foothill (see HR C). Elevation is 240–520 m.

Scientific and Educational Values

Scientific reference. Electrofishing site and instream reference point in Scrubby Creek at Parkers Road above Humevale.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Relatively intact and extensive stands: Mountain Grey Gum damp riparian forest (3.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Broad-leaved Peppermint heathy forest (8.1); Messmate–Swamp Gum gully woodland (10.2); Long-leaf Box–ed Stringybark box–stringybark woodland (11.4)

Partially intact or small stands: Mountain Grey Gum damp sclerophyll forest (4.1); Manna Gum riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Yellow Box–Candlebark valley forest (31.1)

Critical assemblages or populations: Strategic Habitat Link.

FAUNAL SIGNIFICANCE: Site 100 Scrubby Creek Humevale

Assessment: State—Category 2 (B, D, E); Regional (C, D, E, F)

Reference grids for the significance keys include:

100^a: 37° 29' x 145° 10'; Scrubby Creek, Humevale

100^b: 37° 29' x 145° 13'; Scrubby Creek headwaters

100^c: 37° 30' x 145° 10'; Humevale south/Parkers Road

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 100^a: Barking Owl, Powerful Owl, Brush-tailed Phascogale, Common Dunnart, Mountain Galaxias

Regional. 100^c: Mountain Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

e. Honeyeaters

Regional. 100^a: 8 species in flowering Manna Gums upstream of Humevale along Scrubby Creek on 23 March 1991

f. Breeding migratory insectivores

Regional. 100^a: 9 species including Dollarbird, Rose Robin, Leaden Flycatcher, White-throated Gerygone and Masked and White-browed Woodswallows upstream of Humevale by Scrubby Creek on 25 November 1988

h. Bats

Regional. 100^a: 7 species including Gould's Long-eared Bat and Southern Forest Bat by Scrubby Creek at Humevale on 18 December 1989

i. Arboreal mammals

Regional. 100^a: 4 species including Greater Glider and Mountain Brushtail Possum by Scrubby Creek upstream of Humevale on 25 November 1988

k. Frogs

Regional. 100^a: 6 species including Striped Marsh Frog by Scrubby Creek upstream of Humevale on 15 November 1988

l. Reptiles

Regional. 100^a: 10 species including White's Skink, Coventry's Skink, Southern Grass Skink, Eastern Three-lined Skink and White-lipped Snake from a four hour search in heathy forest/herb-rich foothill forest by the Whittlesea–Yea Road some 5 km west of Kinglake West on 18 December 1991

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 100^a: 166 species

b. Native birds

State. 100^a: 119 species

c. Native mammals

State. 100^a: 24 species

d. Herpetofauna

Regional. 100^a: 23 species

e. Freshwater fish

Local. 100^{ac}: 1 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 100^a: 37 species

b. Regionally endangered fauna (R1 species)

Regional. 100^a: 3 species. **Birds:** Dollarbird, White-bellied Cuckoo-shrike, Noisy Friarbird

c. Regionally vulnerable fauna (R2 species)

State. 100^a: 9 species. Barking Owl, White-throated Nightjar, Azure Kingfisher, Hooded Robin, White-throated Gerygone, Fuscous Honeyeater. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot

d. Regionally rare fauna (R3 species)

State. 100^a: 12 species. **Birds:** Collared Sparrowhawk, Pink Robin, Spotted Quail-thrush, Masked Woodswallow, White-browed Woodswallow. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Greater Glider, Gould's Long-eared Bat. **Reptiles:** Coventry's Skink, Southern Grass Skink, White-lipped Snake

Regional. 100^b: incidental sightings. **Mammals:** Mountain Brushtail Possum, Greater Glider

e. Regionally depleted fauna (R4 species)

State. 100^a: 13 species. **Birds:** Peregrine Falcon, Powerful Owl, Australian King-Parrot, Rainbow Bee-eater, Superb Lyrebird, Leaden Flycatcher, Bassian Thrush, Rufous Songlark, Eastern Whipbird, White-winged Triller. **Mammals:** Platypus. **Reptiles:** White's Skink. **Fish:** Mountain Galaxias

Regional. 100^b: incidental sightings. **Birds:** Superb Lyrebird, Eastern Whipbird

Regional. 100^c: incidental sightings. **Birds:** Leaden Flycatcher. **Fish:** Mountain Galaxias

f. Regionally restricted fauna (R5 species)

Regional. 100^a: 17 species: **Birds:** Painted Button-quail, Brush Bronzewing, Pied Cormorant, Australian Pelican, Great Egret, Nankeen Night Heron, Long-billed Corella, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Water Rat. **Reptiles:** Delicate Skink, McCoy's Skink, Southern Toadlet, Striped Marsh Frog

Local. 100^b: incidental sightings. **Birds:** Red-browed Treecreeper

Local. 100^c: incidental sightings. **Birds:** Rose Robin

g. Nesting birds of prey

Regional. 100^a: Wedge-tailed Eagle

F. POPULATION DENSITY: Viability and Abundance—point census

e. Honeyeaters

Regional. 100^a: 62 birds of 8 species (including 8 Fuscous Honeyeaters and 4 Noisy Friarbirds) in flowering Manna Gums along Scrubby Creek upstream of Humevale on 23 March 1991

i. Bat trapping rate

Regional. 100^a: Average of 11 bats per trap-night by Scrubby Creek just upstream of Humevale on 18 December 1989

j. Electrofishing rate

Regional. 100^c: 100 fish (all Mountain Galaxias) from Scrubby Creek along Parkers Road near Humevale Road bridge on 14 December 1988

m. Regionally rare fauna (R3 species)

Regional. 100^a: White-browed Woodswallow: 5 nesting pair along Scrubby Creek on 25 November 1988. Fuscous Honeyeater: 8 in flowering Manna Gums along Parkers Road/Scrubby Creek on 23 March 1991

n. Regionally depleted fauna (R4 species)

Regional. 100^a: 6 pair of Leaden Flycatchers near Scrubby Creek above Humevale on 25 November 1988.

Regional. 100^c: Mountain Galaxias (see Fj)

Outlook

Bushblock subdivision will lower faunal values unless safeguards and controls within the Bushland Conservation Zone are applied.

FAUNA

(A substantial component of the data was provided by Fred Parry of Humevale.)

Rare or Threatened Fauna

- Bc* **100^a: Barking and Powerful Owls.** The Barking Owl was recorded at Humevale by Fred Parry. Two Powerful Owls were heard calling from Manna Gum riparian forest (5.3) near Scrubby Creek above Humevale on 25 November 1988.
- Bc* **100^a: Brush-tailed Phascogale and Common Dunnart.** The phascogale was recorded at Humevale by Fred Parry. The dunnart was recorded under a log on an exposed ridge in Broad-leaved Peppermint heathy forest (8.1) along the Whittlesea–Yea Road about 5 km west of Kinglake West.
- Bc* **100^a: Mountain Galaxias in Scrubby Creek.** Above Humevale, the Scrubby Creek contains a large population of the Mountain Galaxias. About 100 were recorded on 14 December 1988 in the section along Parkers Road upstream of Humevale Road (McKenzie & O'Connor 1989). The upper and middle reaches of the stream contain high quality riparian and instream habitat. The lower reaches are somewhat degraded.

Other Significant Fauna

Birds

- Eb* **100^a: Dollarbird, White-bellied Cuckoo-shrike and Noisy Friarbird along Scrubby Creek above Humevale.** The Noisy Friarbird and Dollarbird were common annual breeding migrants (e.g. Whittlesea district; Keartland 1900). Each is now a rare or vagrant visitor to NEM. A Forest Kingfisher from northern Australia was seen in the winter of 1977 (Fred Parry pers. comm.). The drought year in the inland brought vagrants into southern Victoria. It was also recorded in South Warrandyte (Emison *et al.* 1987). The White-bellied Cuckoo-shrike was seen on one occasion (Fred Parry pers. comm.). Two Dollarbirds were breeding in Manna Gum riparian forest (5.3) on 25 November 1988. A Noisy Friarbird was present on this occasion while four were present in flowering Manna Gums (5.3) on 23 March 1991.
- Ec* **100^a: Azure Kingfisher, Fuscous Honeyeater and other riparian birds.** Species recorded only from sections of the creek and at the dam on the Whittlesea golf course included the Australian King-Parrot, Rainbow Bee-eater, Eastern Whipbird, Masked Woodswallow, and waterbirds such as the Pied Cormorant, Australian Pelican, Azure Kingfisher, Great Egret and Nankeen Night Heron. The Fuscous Honeyeater and Noisy Friarbird were each seen feeding amongst flowering Manna Gums along Scrubby Creek at the Parkers Road Picnic Reserve on 23 March 1991.
- Ec* **100^a: White-throated Gerygone and other migratory insectivorous birds.** The riparian forest (5.3), herb-rich foothill forest (6.3) and valley forest (31.1) of the Scrubby Creek valley at Humevale support a high diversity of northern Australian migratory birds. Nine species were recorded in a 30-minute census along Scrubby Creek downstream from the bridge at Parkers Road on 25 November 1988. Eleven significant species were recorded from two visits in spring 1988 (31 October and 25 November). Of these, the Leaden Flycatcher and White-throated Gerygone were seen at their highest densities in GM. Other significant species included the Rainbow Bee-eater, Dollarbird, Brush Cuckoo, Rose Robin, White-bellied Cuckoo-shrike, White-winged Triller, Rufous Songlark, Masked Woodswallow, White-browed Woodswallow and Noisy Friarbird. This is influenced by the prominence of Yellow Box–Candlebark valley forest (31.1), a characteristic habitat of north-eastern Victoria where these migrants visit in greater numbers.
- Ec* **100^a: White-throated Nightjar and other dry ridge birds.** The Spotted Quail-thrush and White-throated Nightjar inhabit bare exposed ridges and hill-slopes supporting Broad-leaved Peppermint heathy forest (9.1) and Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) above Humevale Road.

Ee **100^a: Superb Lyrebird, Bassian Thrush and other damp gully birds.** The sheltered mountain slopes and gullies north-east of Humevale support a diverse assemblage of wet forest species including the Brush Bronzewing, Brush Cuckoo, Superb Lyrebird, Pink Robin (winter visitor from the ranges), Olive Whistler, Bassian Thrush, Red-browed Treecreeper and Crescent Honeyeater.

100^a: Diverse overlap of foothill and mountain forest birds. The site contains a diverse overlap of damp forest and dry woodland fauna. These include many regionally threatened, rare and restricted species because of the strong representation of the herb-rich foothill and valley forest fauna and associated riparian forest fauna. These have close affinity with the Diamond Creek Headwaters site, in the foothills of the Kinglake Ranges.

Mammals

Ec **100^a: Long-nosed Bandicoot and other damp gully mammals.** The sheltered mountain slopes and gullies north-east of Humevale support a diverse assemblage of species including the Dusky Antechinus, Long-nosed Bandicoot, Mountain Brushtail Possum and Greater Glider.

Ee/Ef **100^a: Platypus and Water Rat.** Both were recorded in Scrubby Creek at Humevale.

Reptiles

Ed **100^a: Southern Grass Skink, White-lipped Snake and other mountain reptiles.** White's Skink, McCoy's Skink and Southern Grass Skink inhabit the damp gullies and sheltered mountain slopes where the ground layer is closed with grass tussocks, ferns and ample litter and logs (6.3). Blotched Blue-tongued Lizard, Coventry's Skink and White-lipped Snake inhabit the exposed mountain slopes and ridges with an open layer of low shrubs and grass tussocks (8.1).

Freshwater fish

100^C: Electrofishing Survey: Scrubby Creek–Parkers Road above Humevale

Map reference. 7923 395482. **Altitude.** 260 m. **Survey date.** 14 December 1988.

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Manna Gum riparian forest (5.3; 20% cover; fair condition; alien shrubs 10% cover; advancing). Herbs: Sword Tussock-grass, Tall Sedge, Spiny-headed Mat-rush and Common Maiden-hair (10% cover; fair condition). Alien herbs: Cocksfoot (10% cover; advancing).

Frontage. Messmate herb-rich foothill forest (6.3) and Yellow Box–Candlebark valley forest (31.1; 20% cover; fair condition). Alien shrubs: Prunus (5% cover; advancing). Herbs: Forest Wire-grass, Variable Sword-sedge and Weeping Grass (30% cover; poor condition). Alien herbs: St Johns Wort (10% cover; advancing).

Physical Features:

Pools

Substrate. Pebbles, gravel, some silt and logs on alluvial clay base; bank undercuts; log jams at downstream ends of pools.

Maximum size (mid-summer). 4.0 m wide by 0.6 m deep by 10 m long.

Riffles

Substrate. Pebbles and gravel on sheet sandstone.

Flow (mid-summer normal): Size. 0.5 m wide by 5 cm deep. **Velocity.** 0.4 m/sec. **Rate.** 2.4 ML/day.

Water Quality:

Summer: Temperature. 19.5° C. **Conductivity.** 240 ms. **Turbidity.** Clear.

Fish Recorded During Survey:

Native species numbers/status. Mountain Galaxias (100); likely breeding resident.

Alien species numbers/status. Nil.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
<p>Habitat connectivity. Strategic Habitat Link to sites 91, 97 and 102. Most effective linkage between Kinglake NP (Kinglake Ranges), Plenty River headwaters (Hume Ranges) and Yan Yean Reservoir (Plenty Upland Hills).</p>	
<p>Widespread fragmentation and degradation of valley forest. Much of the foothill woodland fauna habitat, particularly Yellow Box and Candlebark, as elsewhere, has been fragmented by farmland clearing.</p>	<p>Strengthen Strategic Habitat Link. Similar to the Plenty River headwaters, this site forms a Strategic Habitat Link for upland species between a series of significant neighbouring sites. Habitat links within the site are mostly on private land. The formulation of a habitat link strategy to enable the protection and conservation management of these links to the Plenty Valley is viewed as the highest management priority.</p> <p>Target weak links for enhancement works. After identifying key sections, fencing to exclude stock would enable revegetation programs that could reconnect and widen the fragmented links. Creeks and paddock strips beside native roadside vegetation should be the first priority for revegetation.</p> <p>Require protection of valley forest stands. A system of reduced grazing pressure by fencing exclosures should be developed. Understorey shrub layer species should be replanted.</p>

 Regional Hydrological Strategy

Livestock grazing—erosion and weeds in gullies and streams. Livestock grazing has prevented adequate regeneration, particularly of shrub species. The disturbance and soil erosion arising from clearing and livestock grazing in the gullies and along the lower section of Scrubby Creek has led to infestations of Blackberry, Montpellier and Spanish Broom, Tutsan and St Johns Wort. The area has been previously logged and bank erosion and disturbance has led to bank slumping. Loss of native vegetation caused by stock access to freehold sections of the creek and visitor trampling in the vicinity of the Parkers Road Reserve has increased the flow velocity after rainstorms and the degree of bank undercutting.

Bushblock/farmlets—lack of stream flow due to dams. Ongoing habitat fragmentation and degradation caused by bushblock/farmlet subdivision in the lower section of Scrubby Creek is affecting the significant instream and riparian ecosystems downstream near Whittlesea and further down in the Plenty River. This is largely through lack of adequate water flow due to farm dams. Scrubby Creek was electrofished downstream of the site near the Whittlesea showgrounds. The water was polluted, highly turbid and moderately saline. It contained few native fish.

Require fencing of streamway and improved stream flow during summer–autumn. Scrubby Creek supports a substantial population of Mountain Galaxias. The full length of the stream should be fenced from livestock grazing. Further forest clearing or reduced flow caused by building dams in the catchment would be detrimental to instream fauna species. Further applications for dam building in the catchment should only be considered with the provision of an Environmental Impact Assessment addressing the hydrology of Scrubby Creek and the habitat/ecological requirements of the Mountain Galaxias and Platypus.

KINGLAKE RANGES (KR)

Mountain forest catchments of Arthurs Creek (including the Running and Chadds creeks), Diamond Creek (including Broad Gully), Watsons Creek and Steels Creek (including the Jehosaphat and Full and Plenty Creeks).

Land-use

Past land-use: townships, orchards, vegetable growing, timber harvesting and water supply. Present land-use: townships, Kinglake National Park, bushblock and farmlot settlement, orchards, vegetable growing, bushland and outdoor recreation and education (e.g. park information centres, walking trails and picnic areas, particularly Masons Falls).

Native vegetation cover

Extensive except at the margin on the cleared section of the Kinglake Plateau and the Arthurs Creek valley at Strathewen and Steels Creek valley at Steels Creek.

Key Biological Features

Fauna

Birds: Sooty Owl, Barking Owl, Powerful Owl, Red-tailed Black-Cockatoo, White-throated Nightjar, Superb Lyrebird, Southern Emu-wren, Eastern Whipbird, Lewin's Honeyeater.

Mammals: Spot-tail Quoll, Brush-tailed Phascogale, White-footed Dunnart, Southern Brown Bandicoot, Eastern Pygmy-possum, Yellow-bellied Glider, Red-necked Wallaby, Eastern Horseshoe Bat, Common Bent-wing Bat.

Reptiles: Tree Goanna, Mountain Dragon, Black Rock Skink, Metallic Skink, Spencer's Skink.

Fish: Mountain Galaxias, Broad-finned Galaxias.

Butterflies: Anderson's Skipper, Mountain Spotted Skipper, Eliena Skipper, Genoveva Azure, Large Ant-blue, Small Ant-blue, Bright Copper, Yellow-spot Jewel, Victorian Hair-streak, Blotched Blue.

Flora

Netted Brake, Crimson Spider-orchid, Summer Spider-orchid, Green Leek-orchid, Butterfly Orchid, Cliff Cudweed, Tangled Pseudanthus, Swamp Bush-pea, Creeping Grevillea and heathland flora of Broad Gully.

Key habitats

Wet forest/cool temperate fern galleries (particularly Jehosaphat Gully), damp riparian forest, damp sclerophyll forest, riparian forest, heathy forest, herb-rich foothill forests (Messmate and Red Stringybark), gully woodland, heathy woodland and wet heath (Broad Gully).

Significance values

Fauna (particularly birds, mammals and butterflies), habitat, plant and orchid rarity, abundance and diversity; mountain heath ecological reference area (particularly Broad Gully); and strategic habitat links between the ranges and upland hills.

Key areas/physical features for biota

Kinglake NP, Diamond Creek headwaters, Broad Gully/Mt Beggary/Mt Everard, Arthurs/Chadds Creeks headwaters, Bald Spur, Masons Falls, Running Creek/Reservoir, Jehosaphat Gully/Creek, Watsons Creek and Yarra Glen–Mt Slide Road Mine/Fully and Plenty Creek.

4 sites of significance: 3 state and 1 national for fauna and 2 very high and 2 high for habitat.

KR A KINGLAKE NATIONAL PARK WEST

This management unit consists of two sites of state faunal significance (sites 101 and 102) and surrounding land that forms habitat links. Unranked private land in the headwaters of the Deep, Running, Arthurs and Chadds creeks contained in the management unit generally has similar faunal values to the neighbouring section of the park.

Map Reference: 7922 412492 (south point); 7922 428433 (west point); 7923 505439 (north point); 7922 516448 (east point).

Location/Size: Kinglake National Park from Deep Creek to Bald Spur Road and adjoining forested private land. Approximately 3800 ha.

Municipality: City of Whittlesea and Shire of Nillumbik.

Physical Features

The management unit occurs on the overlap of the higher elevation Kinglake Plateau and lower elevation Silurian foothills of the Eastern Uplands. The plateau of the Great Dividing Range forms the northern boundary of the unit and is broader than in the Kinglake National Park East unit. It also contains a major spur with a further side spur (Sugarloaf Spur and Sherwin Ranges) of lower elevation. The Everard Spur and Yarra Ridge of the east unit are rather narrow in comparison. Bald Spur Road and Beale Avenue occur along narrow and steep razorback spurs.

Landforms

Mountain: plateau, spurs, ridges, slopes, valleys (strongly dissected), gullies and streams. Foothill: hill-crests, hill-slopes, valleys, gullies, streams, waterfall and a water storage reservoir (Running Creek). Elevation is 180–600 m.

Hydrology

The management unit contains the headwaters of the Arthurs, Running and Chadds creeks. The perennial Arthurs and Running creeks contain extensive high rainfall catchments at the top of the Great Dividing Range. Chadds Creek has a smaller catchment and stream flow ceases for periods over summer and autumn in most years. The upper sections of the Arthurs and Chadds creeks support Mountain Ash wet forest over fast-flowing streamlets with rock cascades. The valleys of the upper sections of the Arthurs and Chadds creeks are narrow as they descend rapidly off the plateau. Masons Falls on Running Creek is on the most precipitous escarpment of the plateau and drops over 45 m in about three stages.

The lower sections of the Arthurs, Running and Chadds creeks level-off and become broader at about 240 m. The creeks in this section contain cobble riffles. In its upper reaches, Chadds Creek has a series of 10 cascades in a 200 m section of stream, each descending in steps of about 1 m at a time. Shallow (< 0.5 m deep), gravel-bottomed pools with undercut banks occur at the foot of each cascade. The creeks are straddled by huge tree trunks felled during logging. The maximum depth of Running Creek Reservoir is 8.5 m and the surface area is about 30 ha. It is a relatively deep, steep-sided waterbody. The reservoir is managed by Melbourne Water and until about 10 years ago formed part of the water supply for township areas in the outer north-eastern section of NEM (e.g. Hurstbridge). It was recently incorporated into Kinglake National Park.

Rainfall: 750–1100 mm.

Site 101 Arthurs Creek–Chadds Creek Headwaters

- Map Reference:** 7922 476467 to 7923 490490 (Arthurs Creek); 7922 493435 to 7922 515453 (Chadds Creek); 7922 508447 (Chadds Creek cascades); 7922 510434 (Bald Spur lookout). One minute lat/long grids include 37° 29' x 145° 15' to 145° 17', 37° 30' x 145° 15' to 145° 18', 37° 31' x 145° 17' to 145° 19' and 37° 32' x 145° 18'.
- Location/Size:** Southern escarpment of the Great Dividing Range between National Park Road and Bald Spur Road. The site is split into two sections by the Bowden Spur transmission line. Approximately 1080 ha.
- Municipality:** City of Whittlesea.
- Land Tenure/Use:** Public: national park (NRE). Private: uncleared forest in the Arthurs Creek and Chadds Creek valleys at the southern fringe of the national park. The bushland on private land is steep and predominantly unoccupied, apart from a few bushblock residences. Both private and public land sections of the site have been heavily logged. Severe bushfires occurred in 1926 and 1939. Adjoining private land on the Kinglake Plateau is rural and composed of small farmlets and berry and potato farms. Orchards and mixed livestock farms occur in the Strathewen valley.
- Landforms:** Mountain and foothill (see KR A). Elevation is 220–600 m.

Natural Heritage Values

Landscape. Logging and 1939 fire regrowth stands of damp sclerophyll forest occur on the edge of the plateau in the headwaters of Arthurs Creek (e.g. Rifle Range Track). The site is predominantly composed of regrowth damp sclerophyll forests on the plateau and sheltered slopes and heathy forest on the exposed slopes and spurs. The higher elevation valleys of the Arthurs and Chadds creeks support wet forest. Some of the Mountain Grey Gums along the creek valleys are very large and are the principal habitat trees for large hollow-nesting species such as the Powerful Owl and Greater Glider. The Arthurs Creek section supports some of the most extensive stands of damp sclerophyll forest in NEM and intact stands of damp riparian forest at its low elevation limit.

Scientific and Educational Values

Scientific reference. 101^a: Electrofishing site and instream reference point in Arthurs Creek at the boundary of Kinglake NP.

Rehabilitation and management. Kinglake NP. Friends of the Lyrebird.

Public interpretation. Ranger/Friends activities.

HABITAT SIGNIFICANCE

Assessment: High—Category 3

Reference stands: Broad-leaved Peppermint upland scrub (19.1)

Relatively intact and extensive stands: Mountain Ash wet forest (2.1); Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Broad-leaved Peppermint heathy forest (8.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Critical assemblages or populations: Strategic Habitat Link

FAUNAL SIGNIFICANCE: Site 101 Arthurs Creek–Chadds Creek Headwaters

Assessment: State—2 (B, E); Regional (B, C, D, E)

Reference grids for the significance keys include:

101^a: 37° 30' x 145° 16'; Arthurs Creek upper reaches

101^b: 37° 31' x 145° 17'; Beale Avenue/Bowden Spur Road

101^c: 37° 31' x 145° 18'; upper Bowden Spur

101^d: 37° 32' x 145° 18'; Chadds Creek headwaters/Bald Spur Road

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

State. 101^d: Red-tailed Black-Cockatoo (winter visitor)

b. Vulnerable fauna

State. 101^d: Spot-tailed Quoll (breeding)

c. Rare fauna

State. 101^d: Barking Owl, Powerful Owl (breeding), Brush-tailed Phascogale, Common Dunnart, Mountain Dragon, Tree Goanna (breeding), Mountain Galaxias

Regional. 101^a: Powerful Owl, Mountain Galaxias, Broad-finned Galaxias

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 101^a: 5 species including Gould's Long-eared Bat and Southern Forest Bat at Rifle Range Track from 18 to 19 March 1988

i. Arboreal mammals

Regional. 101^a: 4 species including Mountain Brushtail Possum, Sugar Glider and Greater Glider at Rifle Range Track on 18 December 1986

Regional. 101^d: 4 species including Brush-tailed Phascogale and Sugar Glider south of Bald Spur lookout on 12 November 1990

l. Reptiles

Regional. 101^d: 8 species including Tree Dragon, Mountain Dragon, Tree Goanna (2 males), White's Skink, Eastern Three-lined Skink, Coventry's Skink and McCoy's Skink at Bald Spur lookout on 12 November 1990

Regional. 101^d: 6 species including Mountain Dragon, Marbled Gecko, Coventry's Skink, Southern Grass Skink and McCoy's Skink at Woorail, Bald Spur Road on 17 November 1990

Regional. 101^a: 6 species including Blotched Blue-tongued Lizard, Weasel Skink, McCoy's Skink and Lowland Copperhead along Arthurs Creek at the NP boundary on 14 April 1992

m. Freshwater fish

Regional. 101^a: Short-finned Eel and Mountain Galaxias from Arthurs Creek at the NP boundary on 14 April 1992

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 101^d: 125 species. **101^a**: 80 species

b. Native birds

Regional. 101^d: 85 species. **101^a**: 55 species

c. Native mammals

Regional. 101^d: 20 species. **101^a:** 14 species

d. Herpetofauna

Regional. 101^d: 20 species. **101^a:** 11 species

e. Freshwater fish

Local. 101^a: 2 species. **101^d:** 1 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 101^d: 30 species. **Regional. 101^a:** 17 species

b. Regionally endangered fauna (R1 species)

Regional. 101^d: 2 species. **Birds:** Red-tailed Black-Cockatoo. **Mammals:** Spot-tailed Quoll

c. Regionally vulnerable fauna (R2 species)

State. 101^d: 7 species. **Birds:** Barking Owl, White-throated Nightjar. **Mammals:** Brush-tailed Phascogale, Common Dunnart, Long-nosed Bandicoot. **Reptiles:** Mountain Dragon, Tree Goanna

Regional. 101^a: 4 species. **Birds:** Lewin's Honeyeater, Satin Bowerbird. **Reptiles:** Tree Goanna. **Fish:** Broad-finned Galaxias

d. Regionally rare fauna (R3 species)

State. 101^d: 13 species. **Birds:** Fork-tailed Swift, Pink Robin, Spotted Quail-thrush, Large-billed Scrubwren, Pilotbird. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Greater Glider, Feathertail Glider, Gould's Long-eared Bat. **Reptiles:** Marbled Gecko, Coventry's Skink, Southern Grass Skink

Regional. 101^a: 6 species. **Birds:** Collared Sparrowhawk, Pink Robin, Pilotbird. **Mammals:** Mountain Brushtail Possum, Greater Glider, Gould's Long-eared Bat

Regional. 101^b: 1 species. **Reptiles:** Coventry's Skink

e. Regionally depleted fauna (R4 species)

Regional. 101^d: 8 species. **Birds:** Whistling Kite, Powerful Owl, Superb Lyrebird, Leaden Flycatcher, Eastern Whipbird, Bassian Thrush. **Reptiles:** White's Skink. **Fish:** Mountain Galaxias

Regional. 101^a: 7 species. **Birds:** Powerful Owl, Australian King-Parrot, Superb Lyrebird, Eastern Whipbird, Bassian Thrush. **Mammals:** Platypus. **Fish:** Mountain Galaxias

Local. 101^b: 1 species. **Birds:** Superb Lyrebird

f. Regionally restricted fauna (R5 species)

Regional. 101^d: 11 species. **Birds:** Painted Button-quail, Brush Bronzewing, Australian Hobby, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet

Regional. 101^a: 10 species. **Birds:** Painted Button-quail, Nankeen Night Heron, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper. **Mammals:** Koala. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet

Local. 101^b: 3 species. **Birds:** Brush Bronzewing, Red-browed Treecreeper. **Reptiles:** McCoy's Skink

g. Nesting birds of prey/parrots

Regional. 101^d: Powerful Owl and Yellow-tailed Black-Cockatoo

Outlook

Current park management is maintaining faunal values. Perimeter disturbances are increasing with farming intensification above the park between Pheasant Creek and Kinglake and bushblock subdivision below the park at Strathewen. Introduced predators, particularly dogs and cats, are increasing.

FAUNA

Note: no ground mammal trapping was conducted in the site.

Rare or Threatened Fauna

Ba **101^d: Red-tailed Black-Cockatoo.** This species is listed endangered in Victoria (see One Tree Hill site 80 and site 103). Two birds were observed in a feeding group of yellow-tailed blacks amongst Broad-leaved Peppermint heathy forest (8.1) south of Bald Spur lookout on 10 July 1990.

Bb **101^d: Breeding Spot-tailed Quoll at Chadds Creek cascades.** This species is listed vulnerable in Victoria. Four juvenile quolls were seen in Mountain Grey Gum damp riparian forest (3.1) in the mid-1980s (David Bathgate pers. comm.). The area is strewn with hollow fallen trees. The den was probably in one of these. An adult was seen in 1988 at the top-end of Ninks Road, 1.5 m to the south-east in the Diamond Creek Headwaters site. These were the only two recent confirmed sightings in NEM. The species was widespread throughout NEM but declined dramatically during the early and middle twentieth century (see site 103).

Be **101^d: Tree Goanna stronghold.** There were three separate sightings in the Bald Spur lookout area. These included a pair of adult males seen in bipedal combat on 12 November 1990 and a juvenile seen on 17 November 1990. Along with the Mt Everard and Watsons Creek–Steels Creek blocks of Kinglake NP (East), this area forms a stronghold for the species in GM.

In Kinglake NP the Tree Goanna inhabits open vegetation in areas of milder climate. All sightings have been where ample rocks or fallen timber occur. Habitats include middle altitude Broad-leaved Peppermint heathy forest (8.1) and rocky scrub (19.1) at Bald Spur and Mt Everard and lower altitude Messmate herb-rich foothill forest (6.3), Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) and Mealy Stringybark heathy woodland (9.1). In hot weather, they require drinking water provided in creeks, gullies (riparian forest/gully woodland) or fire dams. They occasionally range along spurs into higher altitude damp sclerophyll forest and lowland box–stringybark and valley forest. They seldom enter dense vegetation of steep, sheltered mountain valleys and gullies (e.g. wet forest).

Goannas have been seen basking on tree trunks and rock outcrops or leaning upright at the foot of a tree with hindlimbs on the ground and forelimbs on the butt. They are equally at home on the ground and in trees and are most frequently seen during warm weather from October to April. On two occasions they have been seen basking in cooler weather at the entrance of their tree hollows. Home ranges in Kinglake National Park may be of the order of 400–500 ha. These may contain several roost hollows. Tree Goannas hold their position when approached, relying on their camouflage. Once inside their short flight-distance, they rapidly retreat, gathering a bipedal run before spiralling up a tree.

The juvenile (possibly 15 months old) seen at Bald Spur lookout in November 1990 indicates that the species breeds locally. Clutches range in size from four to 14, normally laid in December and January. The site chosen for laying is usually in a burrow in the ground. They occasionally burrow-out the inside of a warm and damp termite nest in a tree stump or log. The long incubation takes five to seven months. Seldom more than three or four survive far beyond hatchlings. They are relatively long-lived (10 to possibly 20 years) and grow to over 1.5 m long.

Prey are taken from trees and the ground. These include birds eggs and nestlings and small mammals (e.g. Sugar Gliders and baby ringtails) from tree hollows and nests. While on the ground, they uncover by smell buried or hidden prey such as invertebrates, lizards and small rodents. They tear open damp logs in

search of wood-boring beetle larvae, termites and skinks and take young rabbits from burrows. On one occasion a goanna was seen feeding on a road-kill wallaby.

The range and population of the Tree Goanna has dramatically declined in GM. This decline continues and sightings have become rare even in its stronghold in Kinglake NP. The long-term viability of populations in NEM is at risk without active management (e.g. creation of habitat links and protection from shooters). They were formerly widespread in the foothill box-stringybark woodlands. In the early days they were hunted for leather and shot or poisoned because of their inclination to raid poultry farms for eggs.

Since they occupy a large home range, habitat fragmentation due to farming and land settlement has been a major factor in the decline (Hutchinson 1979). The encroachment of bush blocks into the foothills is now forcing them further back into the mountains. Now very rare, their stronghold in NEM is in the uncleared dry foothill forests of Kinglake National Park east of Mt Sugarloaf, and adjacent bushland habitat links on private land between Strathewen and Steels Creek. The apparent absence of the Tree Goanna further west may be the result of logging, clearing and fragmentation of foothill forests on private land at the foot of the southern face of the ranges.

Bc **101a^d: Powerful Owl.** The Arthurs and Chadds creek valleys contain regrowth Mountain Ash wet forest (2.1) and Mountain Grey Gum–Soft Tree-fern damp riparian forest (3.1). An adult Powerful Owl with a juvenile was seen in a Mountain Grey Gum at Chadds Creek cascades in the mid 1980s (David Bathgate pers. comm.). The huge grey gums at the cascades support hollows of the size required by the owl for nesting. Regurgitated pellets and some feathers were found under a large Silver Wattle near Arthurs Creek on 14 April 1992.

Bc **101^d: Mountain Dragon.** They had been recorded in Mountain Grey Gum damp sclerophyll forest (4.1) near the top of Bowden Spur Road in 1975/76 (Mark Hutchinson pers. comm.). They were recorded in this survey in similar vegetation along upper Bald Spur Road at ‘Woorail’ and in upland scrub (19.1) at Bald Spur lookout. The Mountain Dragon is infrequently associated with damp forest except on the more open and well-drained spurlines. They have been recorded between 350 m and 600 m elevation in Kinglake NP.

As the elevation along the spur rises from 330 m to 530 m, the dominant eucalypt of the sclerophyll forests along the spur changes from Red Stringybark to Broad-leaved Peppermint to Messmate to Mountain Grey Gum. The abrupt relief and rainfall transition on the southern escarpment of Kinglake National Park has created an overlap (sympatry) of species which are normally separate (e.g. the Mountain Dragon and Tree Dragon at Bald Spur lookout). The stronghold of the Tree Dragon is lower elevation, rocky exposed hill-slopes under box-stringybark woodland. The steep slopes have rapid drainage (causing the skeletal soils) and low soil humidity (Hutchinson 1979). These conditions favour warm temperate species such as the Tree Dragon.

Cool temperate species (e.g. Mountain Dragon and Coventry’s Skink) inhabit the deeper, damper soil and litter under the heathy forest of the upper sheltered slopes and damp sclerophyll forest at higher elevation on the spurline and plateau. Both species of dragon occupy the ridgetop scrub at Bald Spur lookout. The scrub permits high levels of solar radiation to reach the substrate, but the cool climate due to high elevation, flatter terrain and dense ground and low shrub layers retains the soil moisture. The scrub/heath vegetation of the ridge is due to a combination of skeletal soils, low rainfall (rainshadow) and exposure to wind and rain.

The Mountain Dragon, throughout most of its range, is restricted to relict and fragmented patches of heath. Broad-scale shrub and tree dieback caused by the plant pathogen Cinnamon Fungus, could threaten the dragon. In the ranges of NEM, death of low shrub species (e.g. Austral Grass-tree, Hairpin Banksia and Dagger Hakea) and trees (e.g. Red Stringybark) susceptible to the fungus has been observed. The spread usually breaks away from road and track-sides.

The Mountain Dragon is very rare in logging areas of damp sclerophyll forest in the Mt Disappointment State Forest. The rarity may be related to an inability of the dragon to adjust to the

frequency or timing of the control burning regime and degree of habitat alteration and fragmentation (e.g. loss of cover, spread of weeds such as Blackberry and increased exposure to fox, cat and bird predation).

Bc **101^{ad}: Mountain Galaxias.** The main tributary of Chadds Creek was walked from Rankines Road to the source on 7 June 1992. Three Mountain Galaxias were seen below the logging track bridge (Fraser Road; site 86). The creek had stopped flowing and none were recorded in the shallower pools of the cascades (about 1 km upstream of the bridge). When the creek was in high flow on 9 November 1992 the same section yielded about 10 galaxias at the cascades. These either move up from the deeper pools downstream or may survive low flow periods at the cascades in water-filled, sub-surface rock fissures. A single Mountain Galaxias was electrofished from Arthurs Creek at nearby Kinglake NP on 14 April 1992.

Other Significant Fauna

Birds

Ec **101^d: White-throated Nightjar and other ground birds at Bald Spur lookout.** The vegetation at the lookout is Broad-leaved Peppermint upland scrub (19.1) on an exposed knoll. Two observations of White-throated Nightjars were made near the lookout. The Painted Button-quail and Spotted Quail-thrush were also recorded.

101^a: Lewin's Honeyeater, Satin Bowerbird and other damp forest birds of Arthurs Creek. Fifty-seven native species were recorded in an one-hour search at the electrofishing site on 14 April 1992. At 235 m elevation, the creek vegetation changes from Mountain Grey Gum damp riparian forest (3.1) to Manna Gum riparian forest (5.3). The exposed slopes of the valley support Messmate herb-rich foothill forest (6.3) flanking the creek while the sheltered slopes support Messmate damp sclerophyll forest (4.2).

Significant species include the Powerful Owl (see *Bc*), Australian King-Parrot (one in the tree canopy), Superb Lyrebird (one amongst the Soft Tree-ferns by the creek and another heard upstream), Pink Robin (one in the Silver Wattles along the creek), Olive Whistler (one), Pilotbird (one in the Austral Bracken/Rough Tree-fern sheltered valley undergrowth), Lewin's Honeyeater (one in the shrubbery along the creek) and Satin Bowerbird (one under a Hazel Pomaderris grove).

101^d: Bird list for 'Woorail' on Bald Spur. The dominant vegetation is Mountain Grey Gum damp sclerophyll forest (4.1). Mountain Ash wet forest (2.1) is present nearby in the headwater valleys to each side of the spur (Chadds Creek and Diamond Creek). Broad-leaved Peppermint heathy forest (8.1) and upland scrub (19.1) are present at lower elevation at Cookson Hill–Bald Spur lookout. The area is at the point where the spur breaks from the plateau. The unusual climate and topography of Bald Spur provides a geographic overlap of wet and dry mountain forest habitats (see Mountain Dragon). A bird list of 68 native species, 24 of which have been recorded breeding, was kindly provided by long-term resident, Karma Hastwell. Significant sightings include:

- Yellow-tailed Black-Cockatoo (breeding in a Mountain Grey Gum)
- Barking Owl (frequently heard)
- Fork-tailed Swift (seen at more frequent intervals over the ranges than in the lowlands of NEM)
- Superb Lyrebird (breeding resident; a number have been taken in recent years by cats)
- Pink Robin (spring–summer resident, probably breeding in the regrowth Silver Wattle headwater valleys of Chadds Creek and Diamond Creek to each side of Bald Spur)
- Olive Whistler (breeding)
- Eastern Whipbird (breeding; declined over the last three to four years due to predation from increasing numbers of cats and competition from Common Blackbirds)
- Pilotbird (breeding resident until three to four years ago; decline possibly due to cats)
- Crescent Honeyeater (spring–summer breeding resident).

Mammals

101^d: Mammal list for 'Woorail' on Bald Spur. The list provided by Karma Hastwell contained 13 species. Significant records include the Dusky Antechinus (common), Long-nosed Bandicoot (occasionally seen; resident), Mountain Brushtail Possum (breeding resident; common brushtails occur at the top of Bald Spur Road in the township area of the Kinglake Plateau) and Feathertail Glider. An additional species, the Greater Glider, was seen in this survey on 12 November 1990 in a Mountain Grey Gum at Woorail.

Reptiles

101^d: Marbled Gecko at upper Bald Spur Road. The only known occurrence in the Kinglake Ranges is at Woorail. They are nocturnal animals and live under logs amongst Mountain Grey Gum damp sclerophyll forest (4.1) near the house (Karma Hastwell pers. comm.). They are occasionally seen on the outside of the house windows where they take moths attracted to the light from inside. Their presence is probably influenced by the presence of sandstone on Bald Spur.

Freshwater fish

101a: Electrofishing Survey: Arthurs Creek at Kinglake NP boundary

Map reference. 7922 477470. **Altitude.** 235 m. **Survey date.** 14 April 1992 and 5 July 1992 (water quality and flow readings).

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Mountain Grey Gum damp riparian forest (3.1; 30% cover; good condition.); lowest altitude on Arthurs Creek. Alien shrubs: Tutsan (10% cover) and Blackberry (5% cover; advancing). Herbs: Sword Tussock-grass, Spiny-headed Mat-rush, Common Maiden-hair and Tall Sedge (10% cover; good condition). Alien herbs: nil.

Frontage. Messmate damp sclerophyll forest (4.2; 20% cover; good condition). Alien shrubs: nil. Herbs: Forest Wire-grass, Variable Sword-sedge, Tall Sedge and Weeping Grass (20% cover; good condition). Alien herbs: nil.

Physical Features:

Pools

Substrate. Gravel, pebble, cobble, boulder, sand, logs and branches on sheet siltstone; undercut banks; log-jammed cascades at downstream end of pools.

Maximum size (mid-autumn). 2.0 m wide by 0.5 m deep by 20 m long.

Riffles Substrate. Gravel, pebble, cobble, boulder and sand on sheet siltstone; cascades.

Flow (mid-autumn minimum): Size. 1.0 m wide by 5 cm deep. Velocity. 0.6 m/sec. Rate. 7.1 ML/day.

Flow (mid-winter normal): Size. 2.5 m wide by 8 cm deep. Velocity. 0.8 m/sec. Rate. 38 ML/day.

Water Quality:

Autumn. Temperature. 17.0°C. Conductivity. 80 ms. Salinity. 0 ppt. Turbidity. Clear.

Winter. Temperature. 10.2°C. Conductivity. 52 ms. pH. 6.56. Dissolved Oxygen. 11.0 ppm. Turbidity. Clear.

Fish Recorded During Survey:

Native species numbers/status. Short-finned Eel (2); migratory sub-adult. Mountain Galaxias (1); likely breeding resident.

Alien species numbers/status. Brown Trout (37); likely breeding resident; larger fish in downstream dam.

Other comments. The site was where Arthurs Creek leaves Kinglake NP. Thirty seven Brown Trout were taken along with two Short-finned Eels and only one other native fish (a lucky Mountain Galaxias). No Broad-finned Galaxias were recorded. Prior to release of Brown Trout, the creek contained a substantial population of Mountain Galaxias and smaller numbers of Broad-finned Galaxias (Bill O'Connor pers. comm.). This section of Arthurs Creek is swift-flowing and

permanent and contains small cascades and several waterfalls (1-2 m tall). The deepest pools at the base of the falls and cascades are about 0.5 m. The undercut banks of the pools provide cover for the trout. A Platypus was seen downstream in winter 1991 (Turid Johanson pers. comm.).

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Strategic Habitat Link to sites 85, 86, 102 and 103.	
<p>Habitat link fragmentation—loss or decline of fauna species. The public land strip along the mountain escarpment is as narrow as a kilometre in places. The forested escarpment has been constricted by land clearing from above on the plateau and below in the Strathewen valley. This may have partly caused the decline of the Yellow-bellied Glider and elimination of the Tree Goanna from the ranges in the western section of NEM. The long-term viability of populations of several wet forest ground and shrub species (e.g. Superb Lyrebird, Eastern Whipbird, Pilotbird, Satin Bowerbird and Lewin’s Honeyeater) in this section should be considered threatened by habitat link fragmentation and predation from cats.</p>	<p>Strengthen Strategic Habitat Link. Bushland rezoning or acquisition in the upper Strathewen valley. Forested private land in Arthurs Creek and Chadds Creek valleys adjoining the national park must be protected. The narrow public land strip on the escarpment would be ineffective as a habitat link should disturbances such as clearing or settlement in the Strathewen valley encroach. Unoccupied bushland should be rezoned to prevent further subdivision and settlement as it forms a buffer strip for the park. If funds permit and these blocks become available, they should be acquired into the park.</p>

 Regional Hydrological Strategy

Brown Trout competition with native galaxias. The presence of a large population of Brown Trout has almost eliminated the Mountain Galaxias from the upper part of Arthurs Creek and contributed to the recent elimination of the Broad-finned Galaxias. Trout prey on galaxias and compete with them for terrestrial insects fallen to the water surface.

Reduced stream flow. Flow has likely been substantially reduced with the widespread use of artesian (bore) water on the intensive farmland of the plateau. Production of standing crop equates directly to water loss from the hydrological cycle.

Reduction of Brown Trout population in the upper Arthurs Creek. On the evidence of the deleterious effect of Brown Trout on the native galaxias, stocking of this species in non-captive waters of the Yarra River basin should not be permitted. Possibly, the trout can never be removed from upper Arthurs Creek. Dismantling an instream dam where the adult trout live is a positive step (see site 86). Their release into other waterways should be avoided..

 Other Issues

Past logging and clearing has led to severe land degradation. The wet and damp sclerophyll forests are regrowth. The most recent logging, conducted after World War II, was particularly extensive in the Chadds Creek catchment. Access to the broad creek valley at the foot of the ranges was provided off Fraser Road. Logging tracks (now overgrown) criss-cross the valley and the slopes. A track goes up the course of the creek just below the cascades. There are several levelled logging bays along the valley (now containing dense Hazel Pomaderris).

The creek sustained extensive damage: the channel was scoured and banks undercut. Blackberries (predominantly a low-growing, small leaf species) have moved up the creek from the Strathewen valley. The tall Messmates dominating the sheltered slopes were felled. Messmates on the exposed slopes, despite being of inferior form, were also logged. Heathy woodland on the lower slopes was probably cleared some time later in an optimistic farming attempt.

The exposed slopes now contain severe gully erosion and it appears that rabbits at some time (probably immediately after clearing) tunnelled the gullies. Extensive sheet erosion also occurred and the slopes were contour ripped in an attempt to halt it. There is a severe outbreak of Tutsan along the upper Arthurs Creek.

Research and follow-up rehabilitation from logging. These should include assessments of impacts on stream ecology and hydrology and soil erosion. Much of the soil was lost to the creeks, sustaining great damage to downstream aquatic ecosystems, from which they never recovered. So often, aspects of soil erosion in the upland catchments and soil deposition in the lowland streams are glossed over in post-logging assessments by timber industry scientists. The sheltered slopes were so steep and the exposed slopes so skeletal, that they should never have been logged or cleared. The vegetation has regenerated as time has healed some of the damage, but the substrate in the gullies has not recovered. If logging areas in steep and remote sections of the national park are ever to be returned to a fully natural state, land protection and stabilisation works will be required to repair the damaged ground.

Feral goats at Bald Spur lookout. Noticeable damage to vegetation from goats was observed in the 1980s. They appear to have been culled in recent years, but will require monitoring.

Planning Recommendations

Strategic Habitat Link. Private land areas containing significant stands of habitat in catchments upstream of Kinglake NP should be rezoned to high conservation levels if the viability of faunal populations in the park is to be maintained.

Streamway Conservation: Arthurs Creek and Chadds Creek.

Site 102 Running Creek Headwaters

- Map Reference:** 7922 428433 to 7923 456489 (Running Creek). One minute lat/long grids include 37° 29' x 145° 14', 37° 30' x 145° 14', 37° 31' x 145° 12' to 145° 14' and 37° 32' x 145° 12' to 145° 14'.
- Location/Size:** Kinglake National Park catchment of Running Creek. Approximately 1350 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: Kinglake National Park. Private: adjoining bushland.
- Landforms:** Mountain and foothill (see KR A). Elevation is 180–563 m (Mt Sugarloaf).

Natural Heritage Values

Landscape. Masons Falls is the longest and most spectacular waterfall in Greater Melbourne. It was included in the first intake into Kinglake NP in 1928. Of particular interest is the rare exposure of the highly resistant Devonian mudstone rock strata and its marine fossils including graptolites and trilobites. The forests were extensively logged in the late nineteenth and early twentieth centuries. The regeneration is now of an age where tree hollows are forming and mature fern galleries are present. Later sections incorporated into the park, such as the Arthurs Creek–Chadds Creek Headwaters site, were logged heavily after World War II and were more highly fragmented by freehold subdivision. The section near Running Creek Reservoir supports a diverse representation of lowland habitats, uncommon elsewhere in Kinglake NP.

Scientific and Educational Values

Rehabilitation and management. Kinglake NP. Friends of the Lyrebird.

Public interpretation. Ranger/Friends activities. Estimated annual visitor rates to Masons Falls exceed 80 000. The ranger office has a well prepared audio visual display.

HABITAT SIGNIFICANCE

Assessment: High—Category 1

Reference stands: Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4); Blanket-leaf–Musk Daisy-bush–Blackwood (sheltered) cliff/escarpment shrubland (20.1); Gorse Bitter-pea–Varnish Wattle–Dusty Miller (exposed) cliff/escarpment shrubland (20.3)

Relatively intact and extensive stands: Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Manna Gum riparian forest (5.3); Red Stringybark herb-rich foothill forest (6.1); Broad-leaved Peppermint heathy forest (8.1); Messmate - Swamp Gum gully woodland (10.2)

Partially intact or small stands: Common Reed–Cumbungi–Tall Spike-sedge seasonal wetland (25.7)

Rare species: Cliff Cudweed, Tangled Pseudanthus, Creeping Grevillea (Masons Falls)

Critical assemblages or populations: Strategic Habitat Link. Disjunct cliff/escarpment shrubland sub-communities supporting the above VROTs and regionally threatened Annual Fern, Dwarf Sickie Fern, Rock Quillwort, Golden Everlasting, Fuzzy New Holland Daisy, Sweet Forget-me-not, Cockspur Flower, Smooth Pomaderris and Shade Pellitory at Masons Falls.

FAUNAL SIGNIFICANCE: Site 102 Running Creek Headwaters

Assessment: State—2 (B, D, E, F); Regional (C, D, E, F)

Reference grids for the significance keys include:

102^a: 37° 29' x 145° 13'; Masons Falls

102^b: 37° 31' x 145° 13'; Running Creek Reservoir/west Mt Sugarloaf

B. RARITY: Rare or Threatened Fauna

c. Rare fauna

State. 102^b: Powerful Owl, Common Dunnart, Common Bent-wing Bat, Large-footed Myotis, Mountain Galaxias, Freshwater Blackfish

State. 102^a: Powerful Owl, Mountain Dragon, Mountain Galaxias, Freshwater Blackfish

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 102^b: 5 species including Large-footed Myotis and Common Bent-wing Bat at Running Creek Reservoir from 18 to 19 December 1989

i. Arboreal mammals

Regional. 102^b: 6 species including Koala, Mountain Brushtail Possum, Greater Glider and Sugar Glider along Running Creek Track, 700 m north-west of Mt Sugarloaf on 21 March 1988

Regional 102^a: 5 species including Koala, Mountain Brushtail Possum, Greater Glider and Sugar Glider at Masons Falls on 16 December 1986

j. Ground mammals

Regional. 102^b: 6 species including Common Dunnart, Platypus and Water Rat at Running Creek Reservoir on 23 March 1988

Regional 102^b: 5 species including Brown Antechinus, Dusky Antechinus and Bush Rat along Running Creek Track, 700 m north-west of Mt Sugarloaf on 21 March 1988

l. Reptiles

Regional. 102^a: 8 species including Mountain Dragon, Black Rock Skink, Spencer's Skink, Coventry's Skink and Southern Grass Skink at Masons Falls on 21 March 1988

Regional 102^b: 7 species including Weasel Skink, McCoy's Skink and White-lipped Snake at Running Creek Reservoir on 19 December 1989

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All vertebrate native fauna

Regional. 102^b: 101 species. **102^a**: 62 species

b. Native birds

Regional. 102^b: 55 species. **Local. 102^a**: 40 species

c. Native mammals

State. 102^b: 24 species. **Regional. 102^a**: 11 species

d. Herpetofauna

Regional. 102^b: 19 species. **102^a**: 11 species

e. Freshwater fish

Regional. 102^b: 3 species (Short-finned Eel, Freshwater Blackfish and Mountain Galaxias)

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

Regional. 102^b: 17 species. **102^a:** 7 species

c. Regionally vulnerable fauna (R2 species)

Regional. 102^b: 5 species. **Birds:** White-throated Nightjar. **Mammals:** Common Dunnart, Common Bent-wing Bat, Large-footed Myotis. **Fish:** Freshwater Blackfish

Regional. 102^a: 3 species. **Birds:** White-throated Nightjar. **Mammals:** Red-necked Wallaby. **Reptiles:** Mountain Dragon

d. Regionally rare fauna (R3 species)

State. 102^a: 8 species. **Birds:** Pilotbird. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Greater Glider. **Reptiles:** Black Rock Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink

Regional. 102^b: 6 species. **Birds:** Spotted Quail-thrush. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Greater Glider, Gould's Long-eared Bat. **Reptiles:** White-lipped Snake

e. Regionally depleted fauna (R4 species)

Regional. 102^b: 6 species. **Birds:** Powerful Owl, Superb Lyrebird, Bassian Thrush. **Mammals:** Platypus. **Reptiles:** White's Skink. **Fish:** Mountain Galaxias

Regional. 102^a: 6 species. **Birds:** Peregrine Falcon, Powerful Owl, Superb Lyrebird, Bassian Thrush, Eastern Whipbird. **Fish:** Mountain Galaxias

f. Regionally restricted fauna (R5 species)

Regional. 102^b: 9 species. **Birds:** Painted Button-quail, Australian Pelican, Brush Cuckoo, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala, Water Rat. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet

Local. 102^a: 3 species. **Birds:** Red-browed Treecreeper. **Mammals:** Koala. **Reptiles:** McCoy's Skink

g Nesting birds of prey/parrots

Regional. 102^a: Peregrine Falcon (cliff eyrie at Masons Falls in spring 1996)

F. POPULATION DENSITY: Viability and Abundance—point census

g. Rare/restricted colonial fauna

State. 102^b: Roost of Common Bent-wing Bats (12) and Large-footed Myotis (1) in Running Creek Reservoir outlet tunnel on 18 December 1989

m. Regionally rare fauna (R3 species)

Regional. 102^a: 5 Greater Gliders at Masons Falls on 16 December 1986

Outlook

Current park management is maintaining faunal values. Perimeter disturbances are increasing with farming intensification and bushblock settlement above the park between Kinglake West and Pheasant Creek and below the park in the Eagle Nest Road area of Strathewen.

FAUNA

Rare or Threatened Fauna

Bc 102^a: Powerful Owl and other damp forest birds at Masons Falls. The Powerful Owl was heard calling in Messmate damp sclerophyll forest (4.2) on the mountain slopes west of the picnic area on

16 December 1986. The Superb Lyrebird, Eastern Whipbird, Pilotbird and Red-browed Treecreeper were recorded in damp riparian forest (3.1) along Running Creek by the Lyrebird Circuit in March 1988.

- Bc* **102^b: Common Dunnart on the exposed slopes of Mt Sugarloaf.** One animal was uncovered from under a log in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) below Running Creek walking track on 23 March 1988.
- Bc* **102^a: Mountain Dragon.** One was observed in Broad-leaved Peppermint heathy forest (8.1) above Masons Falls lookout on 21 March 1988.
- Bc* **102^{ab}: Mountain Galaxias and Freshwater Blackfish in Running Creek.** The Mountain Galaxias and Freshwater Blackfish occur in Running Creek above and below Masons Falls (Raadik in prep.). Running Creek Reservoir contains blackfish and Brown Trout. Mountain Galaxias were seen in pools and riffles along the creek below the reservoir on 19 December 1989. It is unlikely that migratory fish such as the Broad-finned Galaxias can negotiate the reservoir spillway. A study into the necessity and feasibility of a fish-way should be conducted.

Critical Assemblages or Populations

- Fg* **102^b: Cave-bats in the Running Creek Reservoir outlet tunnel.** On 19 December 1989 two Common Bent-wing Bats were trapped at the entrance of the tunnel and an additional 10 bent-wing bats (all males) and one Large-footed Myotis were found inside. At this time of the year breeding females are not present in NEM as they have returned to their maternity cave-sites. The bent-wing bats were roosting from the ceiling of the tunnel. The myotis was in a crevice behind a rock slab on the side of the tunnel. Common Bent-wing Bats appear to be resident through the year. During winter, when females are present, over 50 bent-wing bats roost there. The tunnel exit has a locked cyclone gate. The bats pass through the air-space between the top of the gate and the roof of the tunnel. Melbourne Water requires anyone entering the tunnel to use an artificial respirator.

Other Significant Fauna

Birds

- Ec* **102^b: White-throated Nightjar on the exposed slopes of Mt Sugarloaf.** One was located in Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) below Running Creek walking track on 23 March 1988. The species is a migrant to southern Victoria from northern Australia and New Guinea. It arrives in late October and departs in March. This was the latest date in March that it was recorded in the study area. Exposed rocky slopes and ridges supporting heathy forest or box–stringybark woodland over sparse understorey is their principal habitat in Kinglake NP. Birds return to the same area each year to breed. Eggs are laid on the bare ground.

The White-throated Nightjar has been almost eliminated from the lowlands by land clearing and predation from cats and foxes. They are seldom seen near settlement. The extensive tracts of undisturbed bushland in Kinglake NP form some of the most important habitat for the species in GM. Other significant ground birds recorded in the locality included the Painted Button-quail, Bassian Thrush and Spotted Quail-thrush.

102^b: Waterbirds at Running Creek Reservoir. Small numbers of common waterbirds inhabit the shallow upstream arm of the reservoir. A few Australian Pelican, Eurasian Coot, Great Cormorant, Pacific Black Duck and Australian Wood Duck were present on 23 March 1988. The main body of water is too deep, cold and lacking in oxygen to support much plant and animal life.

Mammals

Ee/Ef **102^b: Platypus and Water Rat at Running Creek Reservoir.** Both were seen in the upstream arm on 23 March 1988.

Ed **102^b: Dusky Antechinus and Gould's Long-eared Bat on the Mt Sugarloaf plateau.** Both were trapped under Mountain Grey Gum damp sclerophyll forest (4.1) along Running Creek walking track about 200 m from the Sugarloaf Road on 21 March 1988.

Eb **102^a: Red-necked Wallaby at Masons Falls.** One was seen in the picnic area during the lyrebird count of 12 July 1992 (George Paras pers. comm.).

Ed **102^a: Dusky Antechinus, Greater Glider and other damp forest mammals at Masons Falls.** The Dusky Antechinus was trapped in damp riparian forest (3.1) along Running Creek by the Lyrebird Circuit in March 1988. The Koala, Mountain Brushtail Possum and Greater Glider (5 animals) were spotlighted along the Lyrebird Circuit and the lookout track on 16 December 1986.

Reptiles

Ed **102^a: Black Rock Skink and other reptiles of Masons Falls.** Eight species were recorded at Masons Falls on 21 March 1988. These included the Mountain Dragon, Black Rock Skink, Spencer's Skink, Coventry's Skink and Southern Grass Skink. The Black Rock Skink inhabits the rocky cliffs and ledges of Masons Falls.

Ed **102^b: White-lipped snake and other reptiles between Running Creek Reservoir and Mt Sugarloaf.** A diverse assemblage of 11 species was recorded from two visits (23 March 1988 and 19 December 1989). The White's Skink was recorded in heathy forest (8.1) on the west face of Mt Sugarloaf on 23 March 1988 and the White-lipped Snake and McCoy's Skink were located in Manna Gum riparian forest (6.3) on the floodplain of Running Creek on 19 December 1989.

MANAGEMENT

See other sites in Kinglake National Park.

Threatening Processes	Conservation Measures
Habitat link fragmentation	Habitat connectivity. Strategic Habitat Link to sites 85, 88, 91, 100 and 101.s Strengthen Strategic Habitat Link
Regional Hydrological Strategy	
	Feasibility of installing fish-way at Running Creek Reservoir. Feasibility of summer-autumn water release from reservoir. This would replenish critically low downstream flow rates at this time of year.
Other Issues	
	Cave-bats in Running Creek Reservoir outlet tunnel should be monitored.

KR B KINGLAKE NATIONAL PARK EAST

This management unit consists of one site of national faunal significance (site 103) and one site of state faunal significance (site 104) and surrounding land that forms habitat links. Unranked private land in the headwaters of the Diamond and Steels Creeks contained in the management unit generally has similar faunal values to the neighbouring section of the park.

Map Reference: 7922 540342 (south point); 7922 517451 (north point); 7922 494385 (west point); 7922 566407 (east point).

Location/Size: South of the Great Dividing Range including those portions of Kinglake National Park between Diamond Creek and the Yarra Glen–Mt Slide Road and immediately adjoining private land. Approximately 3900 ha.

Municipality: Shire of Nillumbik (far eastern section) and Shire of Yarra Ranges.

Physical Features

The management unit lies in the Eastern Uplands on the higher elevation Kinglake Plateau in the north and the lower elevation Silurian foothills in the south. The Great Dividing Range runs along the northern perimeter. The flat terrain of the Kinglake Plateau was part of a sedimentary basin under an ancient sea bed, uplifted during the Tertiary Period. High rainfall and dense vegetation has prevented heavy erosion and maintained the level plateau landscape on the top but created heavily dissected valleys and narrow spurs on the steep southern escarpment. The north-south running Everard Spur and Yarra Ridge fall away precipitously on each side. The Everard Spur keeps at a constant elevation (450–490 m) in the northern half and falls consistently in the south. The Yarra Ridge falls quickly at first and then maintains a consistent lower elevation (around 300 m) in the south. There is a large gold mine (Mt Slide Road Mine) and numerous other shafts and alluvial diggings along Wild Dog Creek and Yow Yow Creek near St Andrews and at Chalmers Ridge and along Jehosaphat Creek near Steels Creek.

Landforms

Mountain: plateau, spurs, ridges, slopes, valleys (strongly dissected), gullies and streams. Foothill: hill-crests, hill-slopes, valleys, gullies, streams, dams and goldmines. Elevation is 140–620 m.

Hydrology

The management unit contains the headwaters of the Diamond, Watsons and Steels creeks. Their main tributaries rise in high rainfall catchments at the top of the Great Dividing Range and are perennial streams by the time they reach the foot of the Kinglake Ranges, before entering the upland hills. The upper sections such as the Full and Plenty Creek tributary of Steels Creek contain Mountain Ash over fast-flowing streamlets with small waterfalls and rock cascades. These have formed incised valleys as they descend from the plateau. The lower sections contain pebble and boulder riffles, sand bars and undercut banks surrounding open water pools (< 1 m deep) with fallen tree trunks and exposed roots.

Rainfall: 700–1100 mm.

Site 103 Diamond Creek Headwaters

- Map Reference:** 7922 522441 (Diamond Creek electrofishing/mammal trapping site above north end of Ninks Road); 7922 529393 (Mt Everard); 7922 527416 (Mt Beggary); 7922 520400 (Broad Gully). One minute lat/long grids include: 37° 32' x 145° 19', 37° 33' x 145° 19', 37° 34' x 145° 19' and 37° 35' x 145° 18' to 145° 19'.
- Location/Size:** Kinglake National Park between Bald Spur Road and Everard Trail. Approximately 1400 ha.
- Municipality:** Shire of Nillumbik.
- Land Tenure/Use:** Public: majority is national park (NRE). Private: portions of Diamond Creek valley. The private land is predominantly of small bushblock residences in the hills and small orchard and mixed livestock farms along the creek valley. Gold mining occurred in the creek valleys and gullies in the Nineteenth Century. Private land adjoining the Kinglake Plateau is composed of bushblock residences and small market garden and berry and potato farms.
- Landforms:** Mountain and foothill (see KR B). Elevation is 180–620 m (Bald Spur Road at Mountain View Parade).

Natural Heritage Values

Landscape. The Broad Gully–Black Calf Creek catchment drains from the Everard Spur. It supports a diverse habitat and plant assemblage (orchid flora of around 60 species). The spur is north–south oriented and is an off-shoot of the higher and broader Kinglake Plateau to the north, creating a local rainshadow. This has resulted in the disjunct biogeographical relict of upland scrub on Mt Everard and the incursion of dry lowland habitats (e.g. Red Box–Red Stringybark box–stringybark woodland; 11.1) into its southern foothills. Broad Gully is topographically (and biogeographically) unusual. It drains west to Diamond Creek from Everard Spur (razorback) and is steeply dissected near the spur, but then levels off to a broad, swampy central valley.

The foothills of the southern section of the western perimeter of the park (e.g. lower Ninks Road and Wild Dog Hill) contain stands of herb-rich foothill forest, riparian forest, box–stringybark woodland and valley forest. In the north along the upper Diamond Creek, there is a fine stand of damp riparian forest and an extensive area of regrowth wet forest (2.1). The topography and climate provides one of the most rapid transitions from dry foothills woodland to wet mountain forest in southern Victoria. Upper Ninks Road was burnt by bushfire in 1926 or 1939 but escaped the 1962 bushfire which razed Mt Beggary–Broad Gully. Massive Silver Wattles are present along the creek (30 m tall, 1.0 m DBH).

Scientific and Educational Values

Scientific reference. 103^a: electrofishing site and instream reference point in Diamond Creek at Kinglake NP/upper Ninks Road.

103^{bc}: proposed Ecological Reference Area (see Planning Recommendations).

Rehabilitation and management. Kinglake NP. Friends of the Lyrebird.

Public interpretation. Everard Trail.

HABITAT SIGNIFICANCE

Assessment: Very High—Category 1

Reference stands: Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Messmate herb-rich foothill forest (6.3); Broad-leaved Peppermint heathy forest (8.1); Mealy Stringybark heathy woodland (9.1); Messmate–Green Scentbark heathy woodland (9.2); Messmate–Mountain Swamp Gum gully woodland (10.2); Broad-leaved Peppermint upland scrub (19.1); Swamp Bush-pea–Heath Tea-tree damp heath (21.1)

Relatively intact and extensive stands: Mountain Ash wet forest (2.1); Red Stringybark herb-rich foothill forest (6.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Partially intact or small stands: Red Box–Red Stringybark box–stringybark woodland (11.1)

Vulnerable species: Green Leek-orchid

Rare species: Summer Spider-orchid, Swamp Bush-pea

Critical assemblages or populations: Strategic Habitat Link. Mountain Heath Ecological Reference Area: most significant stand of heathy woodland in GM; disjunct damp heath at Broad Gully and upland scrub at Mt Everard; 50 species of orchids and 40 species of regionally threatened plants in the heaths of Broad Gully. These include the Pigmy Clubmoss, Swamp Selaginella, Wiry Centrolepis, Broad-leaf Early Nancy, Black-tongue Caladenia, Small Duck-orchid, Horned Orchid, Green Leek-orchid, Great Sun-orchid, Grey-beard Grass, Pointed Rice-grass, Shiny Buttons, Tiny Sundew, Scarlet Sundew, Wiry Bush-pea, Swamp Bush-pea and Purple Eyebright.

The northern slopes of Mt Everard and western slopes of Mt Beggary support the largest stand of heathy woodland in NEM (over 200 ha). A low-lying seepage area with peaty soils on the southern flank of Broad Gully supports a 5 ha stand of damp heath. This occurs at 250 m elevation and contains the Copper Beard-orchid, Large Tongue-orchid, Yellow Onion-orchid, Tall Leek-orchid and Green Leek-orchid, characteristic of coastal tea-tree heaths in central Victoria. The heath supports the only known population in NEM of the Swamp Bush-pea. This rare endemic of the foothills of the Great Dividing Range is known from about a dozen disjunct localities between Wombat Forest and Gembrook State Forest.

FAUNAL SIGNIFICANCE: Site 103 Diamond Creek Headwaters

Assessment: National—2 (B); State (B, C, D, E); Regional (B, C, D, E, F)

Reference grids for the significance keys include:

103^a: 37° 32' x 145° 19'; Diamond Creek headwaters/upper Ninks Road

103^b: 37° 33' x 145° 19'; Mt Beggary

103^c: 37° 34' x 145° 19'; Broad Gully/Mt Everard

103^d: 37° 35' x 145° 18'; Black Calf—Wild Dog Creeks

B. RARITY: Rare or Threatened Fauna

a. Endangered fauna

National. 103^b: Small Ant-blue (presumed breeding)

State. 103^c: Red-tailed Black-Cockatoo (winter visitor)

b. Vulnerable fauna

State. 103^b: Genoveva Azure, Large Ant-blue (breeding)

State. 103^a: Spot-tailed Quoll

c. Rare fauna

State. 103^a: Grey Goshawk, Powerful Owl, Sooty Owl, Masked Owl, Turquoise Parrot, Brush-tailed Phascogale, Mountain Dragon, Mountain Galaxias, Yellow-spot Jewel

State. 103^c: Barking Owl, Tree Goanna, Mountain Dragon., Tasmanian Skipper

Regional. 103^b: Tree Goanna, Mountain Dragon

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

Regional. 103^a: 6 species including Eastern False Pipistrelle, Gould's Long-eared Bat and Southern Forest Bat upstream of the north end of Ninks Road on 17 November 1990

i. Arboreal mammals

Regional. 103^a: 6 species including Koala, Mountain Brushtail Possum, Greater Glider, Sugar Glider and Feathertail Glider at top end of Ninks Road between 11 and 13 March 1988

j. Ground mammals

Regional. 103^c: 6 species including Southern Brown Bandicoot and Red-necked Wallaby at Broad Gully/Mt Everard in September 1993. **103^a:** 5 species including Spot-tailed Quoll, Long-nosed Bandicoot and Dusky Antechinus upstream of the north end of Ninks Road in March 1988

k. Frogs

Regional. 103^a: 6 species including Growling Grass Frog, Victorian Smooth Froglet and Striped Marsh Frog at top end of Ninks Road on 3 April 1987

l. Reptiles

State. 103^c: 14 species including Mountain Dragon, Tree Dragon, Tree Goanna, Southern Water Skink, White's Skink, Delicate Skink, McCoy's Skink, Coventry's Skink, Southern Grass Skink, Eastern Three-lined Skink and White-lipped Snake in 4-hour census at Broad Gully/Mt Everard on 21 September 1993

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

State. 103^a: 174 species

b. Native birds

State. 103^a: 131 species

c. Native mammals

State. 103^a: 28 species

d. Herpetofauna

Regional. 103^c: 16 species. **103^a:** 14 species

e. Freshwater fish

Local. 103^a: 1 species

f. Butterflies

State. 103^c: 32 species. **Regional. 103^b:** 26 species. **103^a:** 18 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 103^a: 52 species. **State. 103^c:** 29 species.

b. Regionally endangered fauna (R1 species)

State. 103^a: 11 species. **Birds:** Little Button-quail, Peaceful Dove, Wonga Pigeon, Grey Goshawk, Sooty Owl, Masked Owl, Turquoise Parrot, Dollarbird, Scarlet Honeyeater. **Mammals:** Spot-tailed Quoll, Eastern Pygmy-possum

State. 103^c: 5 species. **Birds:** Red-tailed Black-Cockatoo, Southern Emu-wren. **Mammals:** White-footed Dunnart, Red-necked Wallaby. **Butterflies:** Blotched Blue

State. 103^b: 4 species. **Butterflies:** Genoveva Azure, Large Ant-blue, Small Ant-blue, Blotched Blue

c. Regionally vulnerable fauna (R2 species)

State. 103^c: 11 species. **Birds:** Barking Owl, Blue-winged Parrot, White-throated Nightjar, Chestnut-rumped Heathwren **Mammals:** Southern Brown Bandicoot. **Reptiles:** Tree Goanna, Mountain Dragon. **Butterflies:** Mountain Spotted Skipper, Eliena Skipper, Tasmanica Skipper, Bright Copper

State. 103^a: 10 species. **Birds:** White-throated Nightjar, Black-eared Cuckoo, Cicadabird, Lewin's Honeyeater. **Mammals:** Brush-tailed Phascogale, Long-nosed Bandicoot, Yellow-bellied Glider. **Reptiles:** Mountain Dragon. **Butterflies:** Anderson's Skipper, Victorian Hair-streak

Regional. 103^b: 3 species. **Reptiles:** Tree Goanna, Mountain Dragon. **Butterflies:** Eliena Skipper

d. Regionally rare fauna (R3 species)

State. 103^a: 19 species. **Birds:** Collared Sparrowhawk, Fork-tailed Swift, Pink Robin, Spotted Quail-thrush, Large-billed Scrubwren, Pilotbird, Masked Woodswallow, White-browed Woodswallow. **Mammals:** Dusky Antechinus, Mountain Brushtail Possum, Feathertail Glider, Greater Glider, Gould's Long-eared Bat, Eastern False Pipistrelle. **Reptiles:** Spencer's Skink, Southern Grass Skink. **Butterflies:** Macleay's Swallowtail, Kershaw's Brown, Yellow-spot Jewel

Regional. 103^c: 6 species. **Birds:** Spotted Quail-thrush. **Reptiles:** Spencer's Skink, Coventry's Skink, Southern Grass Skink, White-lipped Snake. **Butterflies:** Common Silver Xenica

Regional. 103^b: 1 species. **Reptiles:** Spencer's Skink

e. Regionally depleted fauna (R4 species)

State. 103^a: 12 species. **Birds:** Brown Quail, Buff-banded Rail, Whistling Kite, Peregrine Falcon, Powerful Owl, Australian King-Parrot, Rainbow Bee-eater, Superb Lyrebird, Leaden Flycatcher, Bassian Thrush, Eastern Whipbird. **Fish:** Mountain Galaxias

Regional. 103^c: 7 species. **Birds:** Brown Quail, Superb Lyrebird, Bassian Thrush. **Reptiles:** White's Skink. **Butterflies:** Flame Skipper, Spotted Brown, Blue Jewel

Regional. 103^b: 2 species. **Butterflies:** Flame Skipper, Blue Jewel

f. Regionally restricted fauna (R5 species)

Regional. 103^a: 14 species. **Birds:** Painted Button-quail, Brush Bronzewing, Pied Cormorant, Great Egret, Little Eagle, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper, White-winged Chough. **Mammals:** Koala. **Reptiles:** McCoy's Skink. **Frogs:** Southern Toadlet, Striped Marsh Frog

Regional. 103^c: 10 species. **Birds:** Brush Bronzewing, Olive Whistler, White-winged Chough. **Reptiles:** Delicate Skink, McCoy's Skink. **Butterflies:** Spotted Skipper, Phigalia Skipper, Bank's Brown, Sword-grass Brown, Dark Purple Azure

Local. 103^b: 3 species. **Butterflies:** Phigalia Skipper, Sword-grass Brown, Dark Purple Azure

g. Nesting birds of prey/parrots

Regional. 103^a: Powerful Owl; probably also Sooty Owl, Wedge-tailed Eagle, Collared Sparrowhawk, Yellow-tailed Black-Cockatoo, Gang-gang Cockatoo

F. POPULATION DENSITY: Viability and Abundance—point census

j. Electrofishing rate

Regional. 103^a: 46 Mountain Galaxias in Diamond Creek upstream of the end Ninks Road on 15 April 1992

m. Regionally rare fauna (R3 species)

Regional. 103^c: 7 Coventry's Skinks at Mt Everard on 21 September 1993

Outlook

Park management is maintaining faunal values.

FAUNA

Rare or Threatened Fauna

Ba 103^c: Red-tailed Black-Cockatoo. This species is listed endangered in Victoria (see One Tree Hill site 80). Over the last decade, birds have been annual winter visitors to the stringybark ranges of One Tree Hill and southern Kinglake NP. The first red-tailed blacks seen in the park were two birds in a feeding group of yellow-tailed blacks south of Bald Spur lookout in winter 1990. Three birds were subsequently located roosting in a Messmate (heathy woodland; 9.2) by Broad Gully Creek in the early morning of 3 June 1993. Observations of feeding birds between 1993 and 1995 at One Tree Hill determined that they flew each day from the NP. These birds had dispersed 300 km from their breeding areas in far-western Victoria.

Ba 103^b: Small Ant-blue Butterfly. This species is listed endangered in Australia and Victoria. Historical occurrences in Victoria are restricted to a radius of 100 km from Melbourne (Heathmont, Glen Waverley, Lilydale, Ocean Grove and Broadford). The ant-blue is presumed eliminated from all but the latter locality by urban development, habitat fragmentation and degradation or changes in vegetation structure (Nigel Quick pers. comm.; David Crosby pers. comm.).

On 15 and 22 January 1994 a male Small Ant-blue was observed in the canopy of a Broad-leaved Peppermint (heathy forest; 8.1) at the summit of Mount Beggary. While positive sight identification was made (with binoculars from near the top of an adjacent tree), the record remains unconfirmed until a voucher specimen is taken under scientific permit.

The Small Ant-blue established a small territory in the canopy of the tallest tree (about 15 m). It was observed with other hill-topping butterflies (Olane Azure, Blue Jewel and Bright Shield Skipper). The ant-blue undertook brief chases of passing Lycaenid butterflies from a vantage on the upper canopy leaves, in a similar situation to the Blue Jewels. The weather over both days was warm (about 25°C), sunny and calm and observations were made in mid-afternoon (1400 to 1700 hours).

Adults normally fly from early November to the end of January, peaking between late November and late December (Nigel Quick pers. comm.). The records at Mt Beggary are late in the flight season and future searches need to be conducted a month earlier. Larvae of the Small Ant-blue are attended by the Coconut Ant (*Papyrius* sp. *nitidus*; see discussion on Large Ant-blue (below) and the Plenty–Janefield site 42). There is circumstantial evidence that ant-blue larvae prey on ant larvae and pupae by ingesting the body fluids (Common & Waterhouse 1981).

Studies at Ocean Grove suggest the ecology is complex. This partly explains the apparent rarity of the butterfly. The female lays eggs at the base of a stump containing the ants. Larval colonies and pupae were observed in dead Golden Wattle stumps amongst the brood galleries of the ant. The final instar larvae pupate around mid to late October and often attach to the roots of a tree or shrub or base of a stump within the ants byre (Nigel Quick pers. comm.). Colonies may be transient and it is likely they require a particular successional stage of vegetation containing an open overstorey structure. Hollow stumps and logs appear essential.

Bb 103^b: Large Ant-blue. This species is listed vulnerable in Australia and Victoria (Douglas 1995). It has been observed over the last two decades in about 10 widespread localities in Victoria. Most observations are of males from hill-tops surrounded by low rainfall, box–stringybark or heathy woodland. Three

localities from the late 1980s are Eltham, North Warrandyte and Kangaroo Ground (Douglas & Braby 1992). On 17 January 1988, a female was observed at North Warrandyte ovipositing amongst the cracks of a dead eucalypt stump containing the nest (byre of fine leaves and grass of the attendant Coconut Ant). Recent sightings of the Large Ant-blue elsewhere in NEM have been in the southern Plenty Gorge (site 42) and near Pound Bend at Warrandyte (site 57).

Several earlier records in Victoria are from sites that have since been destroyed or degraded by urban development or land clearance for agriculture (Douglas 1995). The paucity of records may be partly due to cryptic behaviour. However, colonies of the host ant species are uncommon and localised and colonies of a size apparently needed by the butterfly are rare. . Immature stages of the Large Ant-blue have yet to be located in Victoria.

Two ant colonies were located in Mealy Stringybark heathy woodland (9.1) on the exposed lower slopes of Mt Beggary and Mt Everard. One of these is the largest known in NEM and contains over 100 nests, several of which are over 5 m up stags (fire-killed in January 1962). There are many nests in hollow logs and tree stumps. The ants were swarming around their emerging queens on the trunk of a dead stag in the mid-afternoon of 20 February 1994. When the tree was tapped gently, a female Large Ant-blue was disturbed from a hollow spout, 2 m up the stag.

A sighting of either a male Large Ant-blue or the similar Cuprea Ant-blue had been made at the summit of Mt Beggary on 15 January. On the basis of the confirmed record nearby, it was probably the former species. An occurrence of the Cuprea Ant-blue is not improbable. It has been recorded in similar terrain and habitat at the summit of the Warramate Hills, 30 km to the south-east (Michael Braby pers. comm.). The Cuprea Ant-blue associates with a nocturnal ant in the *Crematogaster* group.

Bb 103^b: Genoveva Azure. This species is listed vulnerable in Australia and Victoria (Douglas 1995). An adult male hill-topped the 'ant-blue tree' at the summit of Mount Beggary in the late afternoon of 22 January 1994. The butterfly repeatedly made sweeping territorial flights before returning to a dead limb above the canopy. The male Genoveva has an angular hindwing with a prominent tail and is faster in flight and almost twice the size of the Olane Azure and Dark Purple Azure. The upper surface of the wings of males are dark purple while the inner half of those of females are sky blue and the outer half are black surrounding a prominent cream patch on the forewing.

The Genoveva largely occurs in inland, dry-country areas and is considered unlikely to breed in the uplands of southern Victoria. Populations in southern Victoria lie outside the optimal biogeographic range and were possibly always localised and small, now made rarer by habitat fragmentation. The species is presumed to have only one generation annually in central Victoria, with adults normally flying from late December to late January.

Males are known to fly some distance to hill-top. This male possibly originated from the lowland box-stringybark woodland and valley forest around St Andrews where the food-plant of the larvae (Box Mistletoe) is abundant on Yellow Box and Red Box. The nocturnal feeding larvae are attended by a Sugar Ant.

This was only the second sighting of the species during the study (see Plenty-Jane field site 42) There have been isolated records in the early 1970s at Kangaroo Ground and early 1980s at Warrandyte. Long established breeding colonies at Long Forest and the lower end of the Lerderderg Gorge in the Bacchus Marsh-Melton district died out in the 1970s (possibly due to over-collection). Apart from one record of a female feeding at flowering Sweet Bursaria near the Coimadai Creek at Long Forest in late December 1987, the butterfly has not been recorded in the district since.

Bb 103^a: Spot-tailed Quoll. One of the highlights of the study was the sighting of a Spot-tailed Quoll in Kinglake NP. The quoll was seen near Diamond Creek about 500 m north of the end of Ninks Road on 11 March 1988. The area was on the margin of wet and damp sclerophyll forest (2.1 and 4.2). This is the only

sighting made by the author during the survey. The only other recent sighting of the Spot-tailed Quoll in NEM was of several cubs, nearby in the upper Chadds Creek (David Bathgate pers. comm.).

Spot-tailed Quolls form pairs and breed in dens during winter but are solitary and live in fallen hollow logs, standing tree hollows and caves at other times of the year. They occupy a large home range. That of the female is of the order of 200 ha while the male may roam over several square kilometres. They are secretive nocturnal predators of small ground and arboreal mammals (e.g. rats and small possums), birds and their nestlings and eggs, reptiles and large invertebrates. They also scavenge carrion (e.g. road-kills) and have been known to take poultry and hunt during the day in times of food-shortage. Ground prey (particularly rabbits) form the largest proportion of the diet.

They only remain in GM in the ranges. Fragmentation of foothill forests and clearing of plains woodlands was a major factor in their elimination from the lowlands. Competition from cats and foxes for limited resources such as prey and denning sites may have also led to their decline (Strahan 1988). These introduced predators are both favoured by the advance of settlement, roads and other disturbances within native forests. The absence of the fox is a contributing factor to the relative abundance of the Spot-tailed Quoll (and Eastern Quoll) in Tasmania.

The Spot-tailed Quoll formerly occurred in the plains and foothills but was always uncommon in the Melbourne district (Wheelwright 1862). They were highly regarded for their pelts in the early days of settlement. Widespread shooting, trapping and poisoning took place (they did not become protected in Victoria until 1935). Trappers around Melbourne remarked that they were caught at a rate of about 1 per 100 Eastern Quolls. They have been eliminated from over half of their pre-settlement range in Victoria. Under current land and forest management they will decline and become prone to extinction (Mansergh 1984).

Since Spot-tailed Quolls occur at low density and occupy large home ranges, viable populations require extensive areas of intact mountain forest. Their continued survival appears dependent on maintaining the integrity of forest ecosystems within their strongholds and establishing habitat links to preserve the genetic integrity of surviving isolated populations.

Bc **103^c: Barking Owl.** The owl was flushed from the dense canopy of a Messmate in the heart of the gully on 10 January 1994.

Critical Assemblages or Populations

Cl **103^c: High reptile diversity—Broad Gully/Mt Everard census, September 1993.** The diversity of vegetation and habitat types and density of the understorey strata supports one of the richest populations of reptiles in Kinglake NP (Hutchinson 1979). This is influenced by the rapid transition from heavily forested, sheltered mountain slopes (damp montane climate) in the headwaters of Broad Gully Creek on the southern side of Mt Beggary through humid heathy flats in Broad Gully, to exposed mountain slopes (dry montane climate) at Mt Everard (see butterfly surveys for vegetation description).

A list was provided by Mark Hutchinson, who surveyed the area in 1975/76 (Hutchinson 1979). Fourteen of these species were subsequently recorded during a 4-hour herpetofauna census on 21 September 1993. These include:

- Mountain Dragon: one in heathy forest (8.1) on the summit of Mt Everard; uncommon and restricted to mountain sections of the park (above 350 m elevation); on several occasions during the 1986–1996 survey, Mountain Dragons were recorded sunning by the side of the Heidelberg–Kinglake Road, immediately below Mt Beggary
- Tree Dragon: moderately common in heathy woodland (9.1) at Broad Gully
- Tree Goanna: one sunning from a Broad-leaved Peppermint hollow (9.1) on the south flank of Broad Gully; another was seen near the summit of Mt Beggary (8.1) in January 1994; one had been seen in 1975/76 along Everard Trail (Mark Hutchinson pers. comm.)
- Southern Water Skink: three under logs near Broad Gully Creek (10.2)

- White's Skink: two in the damp heath (21.1) of Broad Gully
- Southern Grass Skink: two under logs in damp sclerophyll forest (4.2) in the headwaters of Broad Gully Creek
- Eastern Three-lined Skink: one under a log in dry tea-tree heath/heathy woodland (9.1)
- Delicate Skink: four in the Wiry Spear-grass and Thatch Saw-sedge flats of Broad Gully
- Garden Skink: common amongst rocks and logs on the exposed slopes of Mt Everard
- Weasel Skink: two under logs in herb-rich foothill forest (6.3) in Broad Gully
- Coventry's Skink: three under logs in damp sclerophyll forest (4.2) in the headwaters of Broad Gully Creek
- McCoy's Skink: one under a log near the creek (10.2) in Broad Gully
- Lowland Copperhead: one sunning in Heath Tea-tree (21.1) in Broad Gully
- White-lipped Snake: one disturbed from a hollow log in damp heath (21.1) of Broad Gully.

Db 103^a: Upper Ninks Road bird list. This was compiled from ten years observations by the Rogers family, who live adjacent to the NP near the north end of Ninks Road (320 m elevation). The area has a high diversity of habitats and avifauna species as it occurs near the meeting point of the foothills and the mountains. The bird list contained 129 native species, of which 67 were recorded (or strongly suspected of) breeding. These included mountain gully species such as the Powerful Owl and Yellow-tailed Black-Cockatoo.

The surrounding vegetation includes Mountain Grey Gum damp riparian forest (3.1; along Diamond Creek at the top of Ninks Road and in sheltered mountain gullies), Messmate damp sclerophyll forest (4.2; sheltered mountain slopes and valleys), Broad-leaved Peppermint heathy forest (8.1; ridges and exposed mountain slopes), Messmate herb-rich foothill forest (6.3; exposed mountain valleys and sheltered hill-slopes).

Nearby habitats at higher elevation/rainfall to the north include Mountain Grey Gum damp sclerophyll forest (4.1; mountain slopes above 400 m elevation) and Mountain Ash wet forest (2.1; commencing about 500 m upstream of the north end of Ninks Road in Kinglake NP). Manna Gum riparian forest (5.3; downstream along Diamond Creek). Messmate–Mountain Swamp Gum gully woodland (10.2) (foothill gullies) and Mealy Stringybark heathy woodland (9.1; dry tea-tree heath of foothill valleys and exposed hill-slopes) occur at lower elevation/rainfall to the south along Ninks Road.

A summary of significant sightings with annotations kindly provided by Danny Rogers (plus some by the author which are bracketed) is as follows:

- Brown Quail: in rank Yorkshire Fog in adjacent paddock in the summer of 1984–85.
- Painted Button-quail: breeding summer visitor with earliest recorded arrival on 20 October; moderately common on dry ridges and slopes.
- Little Button-quail: autumn 1988 (during an influx into southern Victoria from the inland); on a track through tea-tree below a powerline.
- Buff-banded Rail: a pair with three chicks in adjacent paddock in the summer of 1984/85; at the time the paddock had a marshy gully filled with rank Yorkshire Fog; later found a juvenile believed killed by a fox.
- Peaceful Dove: two seen, summer 1984–85, in paddock adjacent to heathy forest on a ridge; three also seen in January 1991.
- Wonga Pigeon: first sighted on 5 February 1995. Single bird flushed from low in pomaderris by dam near house, to a tall Messmate. Very noisy wing-beat and long, broad tail. Age unknown, but several characters suggested juvenile; unbanded and probably a natural occurrence, but plainly not resident as previously unrecorded; (possibly post-breeding dispersal, as is the case for the Satin Bowerbird and Lewin's Honeyeater, from small, disjunct populations in rainforest pockets in the Kinglake Ranges; equally plausible, given no previous records for the study area, arisen from further afield in the Eastern Highlands; several temporary range extensions of birds into the study area are attributed to the dry conditions of 1994 .

- Collared Sparrowhawk: occasional in summer; seen eating a rabbit.
- Grey Goshawk: a grey phase juvenile seen in May 1990 (presumably a dispersing bird; breeds along mountain streams in NEM).
- Australian Shelduck: a few visit paddocks in Ninks Road valley; usually in winter.
- Masked Owl: first confirmed on 20 April 1994, when a single bird screamed while flying low overhead. Their occurrence in the valley had been suspected for some time because of unfamiliar owl calls. On 22 March 1994, a distant *Tyto* sp. called persistently for 10 minutes from the woodland/forest edge on a ridge-top. It seemed too deep-voiced to be anything but a Masked Owl and appeared to be answering a Sooty Owl which was calling at the same time. On the same night a very loud single note 'yow' (in character with the Masked Owl) was heard from the forest edge.
- Sooty Owl: resident in the gullies, where likely breeding (presumably the headwaters of Diamond Creek; other pairs in NEM known only from Jehosaphat Gully and the Plenty River headwaters). Frequently heard calling during winter–spring. Adults have been heard or seen in all months at Ninks Road, but a juvenile has not been encountered. Once found roosting in the crown of a tree-fern.
- Powerful Owl: heard frequently, breeding resident. Territories are centred on gullies but they do a lot of hunting on slopes and ridges. The house is within earshot of two territories, with a suspected presence of a third. Have heard two calling back and forth with pitch differences suggestive of adult male and female. In 1992 a nest was located in a large Mountain Ash on Diamond Creek, about 600 m upstream of the north end of Ninks Road. This was unsuccessful, but in some years, the presence of newly fledged juveniles indicates they breed locally. One of these was located on 18 December 1990. Have found them roosting several times in Hazel Pomaderris.
- Yellow-tailed Black-Cockatoo: likely breeding resident; flocks can be seen at any time of year, usually 10–30 birds, but sometimes larger; outside the breeding season, flocks of about 80 birds have roosted in the trees along Ninks Road; have seen dependent juveniles being fed but have not located a local nest; have noticed them revisiting and feeding successfully at Hazel Pomaderris and Silver Wattles that they previously killed while searching for borer grubs.
- Gang-gang Cockatoo: likely breeding resident; pairs encountered feeding quietly in the canopy during spring, but have not located a nest (secretive near nests during the breeding season). Despite being more conspicuous and vocal at other times, there appears to be a local influx of birds from late summer through winter, feeding on pods of wattles. They start on seeds of Silver Wattle around December, then Spreading and Narrow-leaved Wattle in late January and February, and finally onto pods of Blackwoods and gum-nuts in autumn. They feed in small flocks or family groups of two to five birds and congregate into larger flocks of 20–30 birds when on the move or roosting.
- Australian King-Parrot: records of one or two vagrants including both immatures and adults.
- Turquoise Parrot: adult female road-kill along Ninks Road in late summer 1986; it had no orange tonings which is a feature of most aviary birds (vagrants appear to extend their range out of the Murray Valley during summer; the recent dry conditions in northern Victoria likely contributed to sightings at Glenburn in December 1994 and Yellingbo in February 1995; likely present near Melbourne historically in the box–stringybark woodlands to the north and west and heathy woodlands to the east, but a major range contraction from southern Victoria occurred in the nineteenth century since when they have been presumed regionally extinct).
- Dollarbird: vagrant; two records, March 1988 and 30 July 1992 (abnormal time in southern Victoria for this summer migrant).
- Black-eared Cuckoo: vagrant; one record of an adult, 10 April 1992.
- Superb Lyrebird: breeding resident of the gullies, moderately common. Most easily found in winter when they are much more vocal. Territories expand during the non-breeding period when they can also be found on ridges, especially when the leaf-litter is wet.
- Rose Robin: breeding summer visitor, abundance seemingly varies from year to year; more seen in spring 1993 than ever before. Arrive early, noted the last week of August in a couple of years.

- Pink Robin: uncommon passage migrant with perhaps one to five encounters in March–April of most years, always brown birds. Heard a bird singing along Diamond Creek in October 1993; it apparently did not stay to breed.
- Cicadabird: occasional summer visitor to the slopes and gullies, first recorded (a pair) in spring 1985 and again in early summer 1986 and 1987; a juvenile in February 1987.
- Olive Whistler: breeding resident of gullies with heathy or shrubby ground cover. Tend to see more in autumn and winter. This is in part due to them making increased use of lawns and open leaf litter, but also suspect a seasonal altitudinal movement is involved.
- Bassian Thrush breeding resident and moderately common. Detectability varies. When breeding, usually from September to December or January, they are restricted to small territories in gullies, and are hard to locate. On close approach to the nest, they perform a conspicuous distraction display by walking slowly across the open ground and leading into the undergrowth, while uttering a reedy contact call ‘tseep’. In the non-breeding period, territories expand and birds are easier to see as they often feed in the open leaf-litter, including the ridges. Most secretive and quiet about February when adults are moulting primaries. Singing at dawn and dusk occurs in all months, but most often while breeding. Adults usually found in pairs in all seasons.
- Eastern Whipbird: breeding resident of the gullies. Annie Rogers believes their numbers have declined at Ninks Road with the recent succession of wet years, along with an increase in numbers of Common Blackbirds (and possibly cats; whipbirds are also present in the riparian shrublands along Diamond Creek in Kinglake NP at the north end of Ninks Road).
- Spotted Quail-thrush: breeding resident of the ridges and exposed slopes; seemingly uncommon but probably less so due to secretive behaviour; seen infrequently at Ninks Road, once in regrowth bracken, acacia and tea-tree. Perhaps some altitudinal migration occurs as most encounters have been in summer.
- Large-billed Scrubwren: breeding resident of the gullies. Localised and more secretive while breeding. Also hard to find in winter as although tame, are rather quiet. See more at this time because they systematically move in small flocks along stretches of gully; (breeding in dense stands of Hazel Pomaderris along Diamond Creek in Kinglake NP at upper Ninks Road).
- Pilotbird: uncommon breeding resident with few records until recently. The wet spring–summer of 1993 seems to have been a good season with three separate breeding territories at Ninks Road.
- Red-browed Treecreeper: common breeding resident, but less so than the white-throated. Localised while breeding to sheltered gullies containing stands of rough-barked Messmate with a few large, smooth-barked Mountain Grey Gums or on the slopes if smooth-barked eucalypts are present. Most often located in spring when they call more frequently. In the non-breeding period territories expand and individuals or parties of two to four birds range more widely. Favours the ridges more than the white-throated in winter.
- Lewin’s Honeyeater: a pair first seen in May–June 1990. More frequent in the winters of 1992/93 and a few remained over spring–summer of these years. These were quite vocal and may be breeding here now in dense stands of wattle associated with gullies; (one was present in a stand of tall Blackwoods and Silver Wattles along Diamond Creek north of the end of Ninks Road, while electrofishing on 15 April 1992; the honeyeater disperses from the mountain gullies in autumn–winter into more open foothill areas where it has been observed in bush gardens and farmland around Cottles Bridge; similar to the Crescent Honeyeater, they readily feed in flowering mistletoe).
- Scarlet Honeyeater: neighbours familiar with the bird had one in their home garden in summer 1985/86. This has planted banksia and abuts a stand of Narrow-leaf Peppermint along Diamond Creek. One was heard near the Rogers home on 29 December 1992, but could not be tracked down for positive identification.

Dc 103^a: High mammal diversity. The diversity of mammals in the Diamond Creek headwaters–upper Ninks Road 1' grid is the highest recorded in GM (28 species) and displays a strong overlap of mountain and foothill species. The Mountain Brushtail Possum and Greater Glider were seen in Mountain Grey Gums

(3.1) along Diamond Creek about 500 m north of the end of Ninks Road while spotlighting in March 1988. Species recorded at upper Ninks Road by Danny Rogers include: Brush-tailed Phascogale (February 1986 and again in early 1993; also a road-kill on Ninks Road; Messmate; 16.3); Eastern Pygmy-possum (April 1988; Messmate; 16.3); Long-nosed Bandicoot (seen less frequently in recent years in the Mountain Grey Gum gully; 3.1); and Yellow-bellied Glider (see Mammals *Eb*).

Df 103^{bc}: High butterfly diversity—Everard Spur–Broad Gully census 1993/94. Twelve surveys were conducted: six in 1993: 3 June, 21 September, 30 October, 15 November, 26 November and 17 December; six in 1994: 10 January (accompanied by Michael Braby and Fabian Douglas), 15 January, 22 January, 23 January, 20 February and 24 March. Thirty-two breeding or presumed breeding species were recorded in the Mt Everard–Broad Gully 1' grid (**103^c**) while 26 species were observed on Mt Beggary (**103^b**).

In Broad Gully, food-plants of skipper larvae including saw-sedges and mat-rushes dominate the tea-tree heath and gullies. These support several disjunct species more typical of coastal heathlands. The gully is sheltered from winds and sunny. This provides optimal breeding conditions for skippers and supports a diverse assemblage (10 species).

The topography and climate provide an overlap of foothill and mountain habitats and butterfly species. Both mountains are hill-topping areas for butterflies. The conical Mt Beggary provides a fine focus (11 species of Lycaenids recorded). Broad-leaved Peppermint heathy forest (8.1) occurs on the exposed mountain slopes (above 350 m) and summit while the sheltered mountain slopes of the headwaters of Broad Gully Creek support Mountain Grey Gum damp sclerophyll forest (4.1) at higher elevation and Messmate damp sclerophyll forest at lower elevation (4.2). The exposed western hill-slopes (below 350 m) of Mt Beggary support Mealy Stringybark heathy woodland (9.1).

Broad Gully lies between the two peaks. It contains heathy woodland (9.1; dry tea-tree heath) on the exposed hill-slopes of Mt Everard while heathy forest (8.1) occupies the exposed mountain slopes and spurs (above 350 m). The summit of Mt Everard supports a disjunct occurrence of Broad-leaved Peppermint upland scrub (19.1). Damp heath (21.1) occurs in the flats of Broad Gully, Messmate–Green Scentbark heathy woodland (9.2) lies between this and the creek while Messmate herb-rich foothill forest (6.3) occupies the sheltered hill slopes and valleys and Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) occupies the lower ridges. The middle reaches of Broad Gully Creek and lower sections of drainage lines are flanked by Messmate–Mountain Swamp Gum gully woodland (10.2) while Manna Gum gully woodland (10.1) flanks the lower reaches of the creek (downstream of the junction with Black Calf Creek).

Lowland habitats including Red Box–Red Stringybark box–stringybark woodland (11.1) and Yellow Box–Candlebark valley forest (31.1) flank the southern hill-slopes of Mt Everard in the Wild Dog Creek area. These extend southwards into the lowland hills beyond St Andrews.

Annual rainfall of the exposed foothills (elevation 200–350 m) is relatively low (700–750 mm). The summits of Mt Beggary and Mt Everard are 493 m and 470 m respectively. The steep western slopes of the north-south aligned Everard Spur deflect rain clouds northward along the more elevated Great Dividing Range. Areas to the south at Mt Everard fall under rainshadow, creating a dry montane climate. The upper sheltered slopes of Mt Beggary have a cool and damp montane climate, more typical of the Great Divide. Significant butterfly species were:

- Donnysa Skipper and Spotted Skipper: several fresh adults of each in the saw-sedge flats (21.1) and dry tea-tree heath (9.1; feeding at blossoming Heath Tea-tree and Rosy Baeckea) of Broad Gully on 26 November; grazing of Thatch Saw-sedge leaves evident and spent pupae (presumably both species) located in shelters amongst the stem bases on 10 January.
- Flame Skipper: fresh female (recently oviposited; Fabian Douglas pers. comm.) amongst Thatch Saw-sedge (larval food-plant) in 9.2 at Broad Gully on 10 January; a male hill-topping Mt Beggary on 24 March.

- Mountain Spotted Skipper: one at the summit of Mt Everard in 19.1 on 26 November; likely breeds on Red-fruit Saw-sedge in the headwater gullies of the sheltered slopes; one of only three known localities in NEM.
- Bright Shield Skipper: most common skipper hill-topping the summits of Mt Beggary and Mt Everard through January and February 1994 (where joined by the equally common Dispar Skipper in March and April); ascends from the mid-stratum foliage of the tallest Broad-leaved Peppermints in constant territorial flights; several feeding in flowering Prickly Tea-tree at the head of Broad Gully on 23 January; larvae feed on *Poa* species.
- Eliena Skipper: fresh female ovipositing on Many-flowered Mat-rush in damp heath (21.1) at Broad Gully on 17 December; four or five fresh males (second generation) hill-topping Mt Beggary on 24 March; two of only three sightings in NEM.
- Phigalia and Phigalioides Skippers: hill-topping Mt Beggary and Mt Everard; Phigalia on 30 October and 15 November and Phigalioides on 26 November and 17 December; both in Broad Gully where they presumably breed on Wattle Mat-rush (9.1).
- Symmomus Skipper: larvae on Spiny-headed Mat-rush (10.2) at Broad Gully on 26 November; adults in same location on 24 March.
- Tasmanica Skipper: fresh male feeding in flowering Broad-leaved Peppermint upland scrub (19.1) near the summit of Mt Everard on 26 November; probably breeds locally on Forest Wire-grass; only record in NEM of this species which has been recently listed as insufficiently known in Victoria.
- Chequered Swallowtail: hill-topping migration at Mt Everard on 15 November; non-breeding irruptive vagrant from the inland.
- Wood White: pupae on Pale-fruit Ballart (21.1) on 21 September and first generation adults on 30 October at Broad Gully; larvae on Cherry Ballart (9.1) on 17 December and second generation adults on 23 January south-west of Mt Beggary; a dozen or more hill-topping Mt Beggary on 23 January, 20 February and 24 March; also breeding locally on Box Mistletoe.
- Imperial White: larvae in Drooping Mistletoe on a Red Stringybark (11.4) on a low spur of Mt Everard on 21 September and larvae/adults on same at the summit of Mt Beggary in January/February 1994.
- Cyril's Brown: most common butterfly in sunny openings along ridge tracks in October/November 1993; adults feeding at flowering Daphne Heath (9.1) in Broad Gully on 30 October; breeds in gullies where larvae feed on *Poa* species and Weeping Grass.
- Spotted Brown and Bank's Brown: both in 9.1 at Broad Gully, the former on 20 February and the latter on 24 March, while the Spotted Brown was also recorded on the western hill-slopes of Mt Beggary on 24 March; larvae of both feed on *Poa* species (latter also recorded on Forest Wire-grass); the Spotted Brown has not been seen in this abundance elsewhere in NEM.
- Common Silver Xenica: several fresh adults in Broad Gully on 24 March; larvae feed locally on Hairy Rice-grass (.2); only recorded at four localities in NEM but likely more widespread in the ranges.
- Sword-grass Brown: female ovipositing on Red-fruit Saw-sedge (4.2) in a sheltered tributary of Broad Gully on 26 November; one or two males defending territories at the summit of Mt Beggary on all visits between mid-November 1993 and late January 1994 and as a second generation on 24 March.
- Dark Purple Azure: female ovipositing amongst Creeping Mistletoe on Mealy Stringybark (9.1) at Broad Gully on 15 November and several small larvae located at same on 17 December; fresh second generation male and female at the summit of Mt Beggary on 24 March (this species does not hill-top in the manner of other azures but is present due to the local abundance of Creeping Mistletoe on the veteran Broad-leaved Peppermints).
- Olane Azure: most common butterfly hill-topping both summits from late November 1993 to late January 1994; starting to thin out by mid-February and a few worn specimens present in late March; advanced larvae located under bark on a Mealy Stringybark branch (9.1) supporting Drooping Mistletoe at Broad Gully on 30 October and a female ovipositing on Drooping Mistletoe on a Red Stringybark (8.1) at the summit of Mt Beggary on 15 January.

- Bright Copper: worn female in 10.2 adjacent to a dry tributary of Broad Gully on 10 January; would breed locally on Sweet Bursaria which occurs on the banks of the tributary.
- Blue Jewel: two to five hill-topping males present on all visits to Mt Beggary in December/January 1993/94; they settle in full sun on the uppermost canopy leaves of the tallest Broad-leaved Peppermint on the summit; a female was observed flying around a Blackwood (9.2) in Broad Gully on 17 December (where presumably breeding).
- Blotched Blue: fresh female ovipositing on Slender Dodder-laurel in damp heath (21.1) at Broad Gully on 26 November and a male seen on 17 December hill-topping Mt Everard; several hill-topping Mt Beggary on 15 January; these were the only records in NEM.
- Common Dusky Blue: larvae on Downy Dodder-laurel (9.1) and fresh adults seen in 9.1 and damp heath (21.1) feeding from flowering Heath Tea-tree, Rosy Baeckea, Daphne Heath and Swamp Bush-pea at Broad Gully on 30 October; adults recorded on all visits to the summits of Mt Beggary and Mt Everard from November 1993 to February 1994.

Other Significant Fauna

Birds

- Eb* **103^c: Southern Emu-wren in Broad Gully.** A group of five birds was seen in the wet heath on 29 July 1994. This population is highly disjunct from the nearest known at Langwarrin North, on the Mornington Peninsula. Foxes and cats and clearing of coastal heathland are threatening the species in GM.
- Ec* **103^c: Blue-winged Parrot, White-throated Nightjar and Chestnut-rumped Heathwren.** Three Blue-winged Parrots were eating under Mealy Stringybark heathy woodland (9.1) in Broad Gully on 3 June 1993. Five or six nightjars were heard calling from ridges and exposed hill slopes (8.1, 9.1) of Mt Everard in late spring 1988. A pair of heathwren was breeding in damp heath (21.1) in Broad Gully on 21 September 1993.
- Ee* **103^c: Brown Quail, Superb Lyrebird and other ground-dwelling birds at Broad Gully.** Mts Everard and Beggary and the intervening Broad Gully form one of the strongholds in NEM for ground-dwelling birds. These include the Superb Lyrebird, Bassian Thrush and Spotted Quail-thrush (several sightings of each in a visit on 21 September 1993). The lyrebirds descend from their breeding areas amongst the fernlands of Mt Beggary into the protected gully for winter. Extensive scrapes are present in the sedgelands under heathy woodland and gully woodland (9.2 and 10.2). A pair of Brown Quail was seen along an old vehicle track through the damp heath (21.1) on 21 September 1993 while a single bird was seen on 10 November 1994.

Mammals

- Eb* **103^c: White-footed Dunnart in Broad Gully.** The damp heath in Broad Gully supports the White-footed Dunnart, which is also adapted to successional vegetation after fire. Several nests composed of grass and bark (one containing an adult) were located amongst dense Wiry Spear-grass on 3 June 1993.
- Eb* **103^c: Red-necked Wallaby at Mt Everard.** Two were seen in upland scrub (19.1) on an exposed spur overlooking Broad Gully, north-west of Mt Everard, on 21 September 1993. The habitat (moist grassy valley adjacent to dry mountain scrub) and solitude provided by Broad Gully–Mt Everard is similar to that where the Red-necked Wallaby occurs in the Pyrete Ranges–Djerriwarrh Creek north of Bacchus Marsh. The wallaby is likely to occur in the Watsons Creek headwaters. The northern Brisbane Ranges, Pyrete-Lerderderg Ranges and Kinglake NP are the only areas in GM where this species is known to remain.

Locally extinct in west Gippsland, the Red-necked Wallaby now has a major range disjunction along the central coast of Victoria (see also Norris *et al.* 1983). This is due to clearing and fragmentation of large areas of the wallaby's habitat (coastal plain and foothill forests) and predation from introduced carnivores (especially dogs and foxes and possibly Pumas, unconfirmed sightings of which have been made near Strathewen and St Andrews). They may be receiving competition from goats for forage and shelter. Other threatening processes operating on the Red-necked Wallaby outside the national park include shooting, trapping and poison baits laid out for rabbits. Though relatively secure in coastal areas of the far-east and west of the state, its long-term security in south-central Victoria may depend on the protection and conservation management of the extensive unfragmented dry mountain forests of Kinglake NP.

- Ec* **103^c: Southern Brown Bandicoot in Broad Gully.** The bandicoot was flushed from a nest amongst dense Wiry Spear-grass and Thatch Saw-sedge in damp heath (21.1) on the southern flank of Broad Gully on 21 September 1993. This is the only record for NEM. The Southern Brown Bandicoot inhabits dense herb and low shrub vegetation in tea-tree heaths, optimally areas regenerating several years after fire (Strahan 1988). The early stages after fire support a high diversity of plants and an abundance of insect food. Later as the vegetation approaches maturity (as in Broad Gully which was last burnt in 1962), the food supply reduces.

The bandicoot occurs in the same area as the Swamp Bush-pea. Both species would be suited if sections of the heathland were burnt to create a mosaic vegetation succession (see Conservation Measures). In the

nineteenth century the bandicoot probably occurred on the Yering Flats in the Yarra Lowland Hills but became locally extinct through habitat elimination.

Ec **103^a: Yellow-bellied Glider in the Diamond Creek headwaters.** Two animals were observed in Mountain Grey Gum damp riparian forest (3/1) at upper Ninks Road over several weeks in March 1993 (Danny Rogers pers. comm.). Intensive searches of the Kinglake and Hume Ranges in the early and mid-1980s failed to locate any animals and the species was presumed extinct in NEM. During the NEM fauna survey the glider was seen in Diamond Creek headwaters in March 1993 and previously in the Steels Creek headwaters in May 1988 and along Watsons Creek at the southern boundary of Kinglake NP in October 1990. The glider was recorded in the lower reaches of Diamond Creek at Eltham North in August 1993. It would appear that the species is slowly making a comeback in the Kinglake Ranges and dispersing along streams into the foothills.

The headwaters of Diamond Creek north of Ninks Road were heavily logged in the mid twentieth century and most of the mature trees (potential glider nest-sites) were removed. Much of the wet forest link across the Kinglake Plateau had been previously cleared for farmland. The presence of a few veteran gums, maturing of the Blackwood–Silver Wattle understorey along creeks, and re-establishment of overland links of regrowth foothill forests has enabled a partial population recovery in the ranges. Recolonisation in the Nillumbik Upland Hills is highly probable, particularly if the width and connectivity of streamway habitat links to the ranges is improved.

Ed **103^a: Eastern False Pipistrelle and other mountain bats in the NP at upper Ninks Road.** Bat traps were set adjacent to Mountain Ash wet forest (2.1) along a walking track near Diamond Creek about 500 m upstream of the north end of Ninks Road on 17 November 1991. Six species were caught including two Eastern False Pipistrelles and two Gould's Long-eared Bats.

Reptiles

Ed **103^b: Spencer's Skink at the summit of Mt Beggary.** On 23 January 1994, a Spencer's Skink foraged on the dead upper limbs of a 15 m tall Broad-leaved Peppermint (heathy forest; 8.1), while the author was observing ant-blue butterflies. It was probably dwelling in small hollows in the stags. The skink is capable of moving along even the undersides of branches.

Ed **103^a: Spencer's Skink and other lizards in the NP at upper Ninks Road.** The area contains damp riparian forest (3.1) and stands of massive Silver Wattles over 30 m tall (regrowth possibly from the 1926 bushfire). A Spencer's Skink was located in a decaying section of a trunk of one of the wattles. Several Southern Grass Skinks, which are uncommon in NEM, were observed under logs amongst dense Forest Wire-grass and rosette ferns.

Freshwater fish

103^a: Electrofishing Survey: Diamond Creek above Ninks Road in Kinglake NP

Map reference. 7922 522441. Altitude. 330 m. Survey date. 15 April 1992 and 2 July 1992 (water quality and flow readings).

Vegetation: Instream. No submerged meadow or emergent herbfield. **Bank.** Mountain Grey Gum damp riparian forest (3.1; 30% cover; excellent condition). Alien shrubs: Blackberry (<1% cover). Herbs: Red-fruit Saw-sedge, Club-sedge, Smooth Nettle, Tasman Flax-lily, Scrambling Coral-fern, filmy-ferns, Common Finger-fern and Shiny Shield-fern (10% cover; excellent condition). Alien herbs: nil.

Frontage. Messmate–Narrow-leaf Peppermint damp sclerophyll forest: (4.2; 20% cover; good condition). Shrubs (20% cover; good condition). Alien shrubs: nil. Herbs: Forest Wire-grass, Tall Sedge, Variable Sword-sedge and Weeping Grass (10% cover; good condition). Alien herbs: nil.

Physical Features:

Pools: Substrate. Gravel, pebble, cobble, sand, logs, branches and leaves on sheet sandstone; undercut banks; log jams at cascades at downstream end of pools.

Maximum size (mid-autumn). 1.5 m wide by 0.3 m deep by 5 m long.

Riffles: Substrate. Gravel, pebble, cobble and sand on sheet sandstone; cascades.

Flow (mid-autumn minimum): Size. 0.5 m wide by 2 cm deep. Velocity. 0.8 m/sec. Rate. 1.9 ML/day.

Flow (mid-winter normal): Size. 1.5 m wide by 5 cm deep. Velocity. 0.8 m/sec. Rate. 14.3 ML/day.

Water Quality:

Autumn: Temperature. 14.0° C. **Conductivity.** 82 ms. **Salinity.**—ve 1 ppt. **Turbidity.** Clear.

Winter: Temperature. 10.5° C. **Conductivity.** 36 ms. pH. 6.35. **Dissolved Oxygen.** 11.2 ppm. **Turbidity.** Clear.

Fish Recorded During Survey:

Native species numbers/status. Mountain Galaxias (46); breeding resident. This was one of the largest populations of the galaxias recorded in NEM (Raadik, in prep.).

Alien species numbers/status. Nil.

Other comments. The native spiny crayfish, *Euastacus woiwuru* was recorded at the electrofishing site (Tarmo Raadik pers. comm.).

Butterflies

103^a: butterfly census—Diamond Creek headwaters. A 600 m transect of Diamond Creek upstream of the end of Ninks Road was surveyed on 17 December 1993, 23 January 1994 and 20 February 1994. Eighteen butterfly species were recorded. Mountain Ash wet forest (2.1) occupies the sheltered gullies and mountain slopes at the upstream end of the transect. This is replaced by Messmate damp sclerophyll forest (4.2) in the downstream section. Mountain Grey Gum damp riparian forest (3.1) with floristic elements of cool temperate rainforest (1.1), including Austral Mulberry and Soft Tree-fern, occurs along the creek. The elevation of the area (320–360 m) is considered the low-level range limit in central Victoria of wet mountain forest. Five of the butterfly species are regionally rare or vulnerable:

- Anderson's Skipper: female ovipositing on Forest Wire-grass and male feeding at flowering Forest groundsel (2.1) in the upper transect on 23 January—an eastern mountain species nearing the end of its range. This species has only been recorded elsewhere in NEM in the Plenty River East Branch headwaters and the Full and Plenty Creek in the east section of Kinglake NP.
- Macleay's Swallowtail: single adult on 17 December, a few hundred metres above Ninks Road, flying in an open section to the east of the creek (old logging camp). Searches in the upper transect on 23 January located several mature larvae (distinctive green with humped thorax) on Mountain Pepper (2.1). A spent pupa (also green) was located on 20 February. Possibly more widespread in the ranges, the butterfly was recorded elsewhere only from the Plenty River East Branch headwaters, where it breeds on Southern Sassafras. Adults fly from November to early March.
- Kershaw's Brown: dozen or more adults on 20 February (2.1, 3.1, 4.2). Larvae feed on Forest Wire-grass, which is locally abundant. Kershaw's Brown is locally common in wet, high elevation areas of the ranges.
- Yellow-spot Jewel: several early instar larvae located on 20 February in a dense stand of regrowth Hazel Pomaderris (3.1) in a flat (old logging bay) by the creek, not far upstream of Ninks Road. These were on the underside of the pomaderris leaves. The Yellow-spot Jewel is difficult to locate and is likely more widespread. It was recorded at only five other localities in NEM (Plenty River East Branch headwaters, Kinglake township, Diamond Creek between Cottles Bridge and St Andrews, Watsons Creek at Christmas Hills and Jumping Creek on the Yarra River). Due to lack of records the conservation status has been listed in Victoria as insufficiently known, but more than likely it will prove to be secure.
- Victorian Hair-streak: an adult female perched on a small Silver Wattle on 17 December, in a stand of old growth wet forest (2.1) at the head of the transect. The larval food-plant is Silver Wattle or less frequently Blackwood, and the females usually oviposit on plants about 2–3 m tall (Fabian Douglas

pers. comm.). Adults fly in late spring–early summer. The only other record in NEM was from higher elevation (650 m), in the Plenty River East Branch headwaters. The hair-streak is a sedentary species with a preference for old-growth forest. Most sightings in the central highlands are from national parks and water catchment areas. It has likely been depleted by clear-felling operations.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Strategic Habitat Link to sites 82, 84, 101 and 104.	
<p>Fragmentation of foothills habitat links. This has occurred through land clearing along the southern and northern perimeter of the park. Disturbance such as weed and vermin invasion is a major management problem. The significant Marshalls Road forest link from the Rifle Range block to the Kinglake National Park has inadequate width and is cut by Buttermen Track.</p> <p>Division between east and west sections of park. A forested private land wedge 1.5–2 km wide separates the upper Diamond Creek and Bald Spur.</p>	<p>Mountain Heath Ecological Reference Area designation. This is proposed for the Mt Beggary–Broad Gully–Mt Everard and Watsons Creek headwaters blocks as they satisfy the criteria for reference area designation (see Planning Recommendations).</p> <p>The area has been largely protected from logging and most other antagonistic human activities apart from small-scale mining in the mid nineteenth century and several bushfires (1926, 1939 and 1962). Undisturbed, intact and extensive areas of mountain foothills habitat are inadequately represented in the biological reserve system of Victoria. They are even more poorly represented in the reference or wilderness area systems. Management of the site must maintain these values.</p> <p>Strengthen Strategic Habitat Link. Maintenance and restoration of foothill habitat links (see Kinglake National Park link, Smiths Gully Creek, Wild Dog Creek and Yow Yow Creek sites) is of critical importance.</p> <p>Linking east and west sections. A major priority would be the acquisition of connecting blocks through land bequests or land purchase. This area is contained in the Diamond Creek Headwaters site.</p>

Regional Hydrological Strategy

Electrofishing site in the Diamond Creek headwaters. Logged after 1939, which has led to bank undercutting. Blackberry is attempting to establish. The water contained unusually high levels of nitrates for a headwater stream in native forest. A possible explanation is leachate from septic tanks in the township of Kinglake. This needs to be investigated as the nitrates may far exceed accepted water quality levels for the Yarra River basin. *E. coli* tests should also be conducted.

Other Issues

Land settlement. This is the major problem for park management. Peripheral sections of the park being disturbed by fires, land clearing, mining and vehicles has led to erosion and changes to ground cover vegetation. Some of the disturbance arises from adjoining properties. The disturbance and debris has facilitated the spread of Blackberries, Common Blackbirds and introduced rodents. Feral populations of goats have been present on Mt Beggary and Mt Everard. Problems include:

- **Foxes, feral cats and dogs.** Populations of predators, particularly foxes but also feral and domestic cats and dogs, are the most prevalent threat to the ground fauna, particularly the viability of the lyrebird population. There is evidence of feral dogs, which have been dumped or gone wild. Most are domestic dogs roaming from properties adjoining the park. Most cats seen in the park are near settled areas, and would appear also to be domestic.
- **Horse riders.** Access can be illegally obtained from several points at the St Andrews end of the park (see also Kinglake National Park Link site). Horse riders also enter the Wild Dog Hill area of the park from the rear of adjoining properties fronting Wild Dog Creek Road and Olives Lane. Tracks lead up the spurs to the Everard Trail. There is another illegal horse riding track, just north of Ninks Road, leading up the spur between the Heidelberg–Kinglake Road and the Everard Trail. Gold mining and settlement along Wild Dog Creek and its feeder gullies have led to an erosion and grassy weed problem. Horse riding is exacerbating both of these. Trail bike riders occasionally enter the park from this end.

Expansion of ranger presence in the southern perimeter of the park. This is required to control the incursions of trail bike and horse riders, and upgrade the surveillance of woodcutters, rubbish dumpers and shooters.

Exclusion of horse riding from the ERA and the Everard Trail. It is becoming increasingly apparent on biological grounds that any proposal for a Yarra to Kinglake horse trail, and indeed any horse riding, should exclude the Everard Trail. Other factors add to the unsuitability of the area for riding. The side spurs enable riders to trespass off the trail. This would be very difficult to stop. One of the illegal tracks (from Ninks Road to Mt Beggary) passes very close by the research colony of the Coconut Ant, which could give rise to interference with equipment. The spurs lead through steep and inaccessible terrain, which could be hazardous in the event of an injury to a horse rider. The whole issue of horse riding in Kinglake NP requires close investigation and regulation.

Conflicting management of adjoining private lands. A property surrounded on three sides by park to the east of the picnic area along Wild Dog Creek Road is heavily cleared and grazed and has become severely degraded over recent years. Most remaining trees on the property have been ringbarked by livestock. The headwaters of the Wild Dog Creek run through this property. It contains sphagnum bogs and Prickly Tea-tree scrub, likely habitat for Swamp Rats. Livestock trample the marshland. Patches of Red Stringybark in poorly drained areas show dieback symptoms. These may be caused by the activity of the Cinnamon Fungus (*Phytophthora*). Some rubbish dumping and timber removal also occurs in the Wild Dog Creek section of the park. Bell Miner/eucalyptus dieback and weeds have become a problem along the creek.

Rezoning significant freehold bushland adjoining the park. Private land areas containing significant stands of habitat in catchments upstream of Kinglake NP and bordering farmland/freehold bushland in the Diamond Creek valley along the western perimeter of the site should be rezoned from Landscape Interest to Conservation. This must be achieved if the viability of faunal populations in the park is to be maintained.

Other Desirable Conservation Measures

Nomination of Mt Beggary, Broad Gully and Mt Everard as a threatened butterfly community. The proposed Ecological Reference Area (ERA), in addition to likely breeding populations of the endangered Small Ant-blue and Large Ant-blue, contains 32 other breeding species of butterflies. Searches for juvenile stages of the ant-blues are being conducted. Broad Gully contains extensive areas of tea-tree heath. Confirmation of breeding of both ant-blue butterflies in the ERA would:

- facilitate nomination as a threatened butterfly community (mountain heath) under Schedule 2 of the *Flora and Fauna Guarantee Act 1988*;
- meet additional criteria for national faunal significance; and
- assist in the determination of the area as Critical Habitat for ant-blue butterflies under the FFG Act.

Research on the Small Ant-blue. Attempts in January 1994 to catch the butterfly from the top of the hill-topping tree at the summit of Mt Beggary were unsuccessful. The most effective way to secure an ant-blue (and confirm the occurrence), would be from a boom-lift (cherry-picker) platform or 15 m scaffolding tower at the summit of Mt Beggary.

The ecology of the Small Ant-blue would suggest that it breeds locally (within a 5 km radius). A very large and relatively accessible ant colony has been located on the exposed hill-slopes of Mt Beggary. Another ant colony was located in Broad Gully. The ant requires a sunny and well-drained aspect. Both colonies were in floristically similar habitat to where the ant-blue occurred at Heathmont. A female Large Ant-blue was located at the large ant colony on 20 February 1994. It is possible the colony supports both species of ant-blues.

Research at the ant colony during the flight season to obtain a specimen could include erecting tents to trap emerging adult butterflies and surveillance for ovipositing females. Searches of the ant nests for advanced butterfly larvae should be conducted in late winter/early spring. Numerous hollow logs containing ant brood are present. Log traps of similar construction to those at the Plenty-Jane field site need to be laid down. This technique has recently uncovered pupae of the Small Ant-blue at Mt Piper near Broadford.

Swamp Bush-pea at Broad Gully. At least half the known populations of the Swamp Bush-pea occur on unreserved land or within hardwood production forest. The Swamp Bush-pea population in Broad Gully is the largest and most secure known. Management should conduct a long-term monitoring program of the Swamp Bush-pea at Broad Gully as the reproductive plant population is dwindling in areas last burnt in

1962. In the continued absence of hot bushfire, a trial burn of one of the stands to induce regeneration may need to be considered. This would also benefit the Southern Brown Bandicoot.

A section of damp heath in Broad Gully was burnt in 1984. This supports Thatch Saw-sedge and a bush-pea and tea-tree dominated shrub layer. The remainder of Broad Gully was last burnt in the January 1962 bushfire. These areas have reverted to dense herbfield dominated by Wiry Spear-grass, unfavourable for the bush-pea. Ecological burning of sections of the long unburnt area should be conducted so that a mosaic of successional heath is established. This would also benefit most of the rare orchid assemblage present and the Southern Emu-wren, Southern Brown Bandicoot and White-footed Dunnart.

Goat culling on Mt Beggary. Sightings increased through the 1980s and there was ample evidence of goat browsing on the Cherry Ballarts and Oyster Bay Pines. Culling by parks staff in the early 1990s was reasonably successful, but over the last two years populations have re-established.

Blackberry control along Diamond Creek. This should be conducted along upper Ninks Road as a priority as this area otherwise contains few weeds. Blackberry outbreaks upstream in the national park are still only localised.

Wild Dog Creek conservation and land protection works. Blackberry monitoring and control is also required along Wild Dog Creek. The section of the creek on private property, upstream of Kinglake NP, should be fenced from livestock. The ground would be able to repair and the marshland vegetation would regenerate. Sections of freehold frontage along the creek downstream of the Park require concerted conservation management (see Wild Dog Creek site). This would strengthen the riparian habitat link from the national park to Diamond Creek.

Planning Recommendations

Mountain Heath Ecological Reference Area (ERA): Broad Gully–Watsons Creek headwaters. The proposed ERA contains the Broad Gully–Black Calf Creek catchment of Kinglake NP including the spurline from Mt Beggary to Mt Everard and the headwaters of Watsons Creek. It rises from 220 m on the western and southern perimeters to 493 m at Mt Beggary and 470 m at Mt Everard. The ERA requires restricted public access conditions and nature conservation of all native habitat to be the principal planning/land-use priorities. The ERA has access available along its western boundary (Heidelberg–Kinglake Road) and along the eastern perimeter via the Everard Trail and Bundy Track. Vehicle access along the Everard Trail would need to be maintained for management, research and emergency procedures. The interior sections are steep and inaccessible, and should remain closed to vehicles. The Everard Trail should be closed to horse riding.

The ERA encompasses land in Kinglake NP and contains specific conservation and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). A buffer zone is provided by surrounding land in Kinglake NP apart from a small section of freehold bushland near the junction of Broad Gully and Black Calf Creek in the south-west corner. The negotiation of conservation covenants or similar conservation agreements over this freehold bushland would be desirable.

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the ERA include:

- principal butterfly hill-topping area on Mt Beggary; Lycaenid butterfly assemblage including the vulnerable Large Ant-blue and Genoveva Azure and endangered Small Ant-blue;
- damp heath (5 ha stand on flats with impeded drainage in Broad Gully; habitat rarity and biogeographic significance; largest known stand of the Swamp Bush-pea; high diversity of regionally rare or threatened plant species; rare and diverse orchid assemblage including the Green Leek-orchid, Tall Leek-orchid, Yellow Onion-orchid, Copper Beard-orchid and large populations of the Large Tongue-orchid; Southern Emu-wren, Southern Brown Bandicoot and White-footed Dunnart; and rare and diverse butterfly assemblage including the regionally endangered Blotched Blue;
- heathy woodland (over 200 ha on the northern hill-slopes of Mt Everard and western hill-slopes of Mt Beggary; most extensive and intact stands in GM; rare and diverse orchid assemblage including the Small Duck-orchid, Summer Spider-orchid, Variable Midge-orchid, Horned Orchid and Brown-beaks; most of these species are in character with the foothills (e.g. Heathmont–Montrose area) rather than ranges and are inadequately reserved in GM; Coconut Ant, attendant to the ant-blue butterflies; and rare and diverse butterfly assemblage including the Large Ant-blue;
- gully woodland (below 300 m elevation); these are in character with lowland sections of Diamond Creek downstream of St Andrews, and are inadequately represented in the biological reserve system; the stand of gully woodland in Broad Gully is very intact; butterfly and orchid assemblages;
- upland scrub on Mt Everard; endemic and biogeographically significant habitat; Red-necked Wallaby;
- heathy forest on the exposed mountain slopes and mountain spurs (above 350 m elevation; extensive stands in the interior of the park); Tree Goanna, Mountain Dragon, Spencer's Skink; ground fauna including the White-throated Nightjar;
- damp sclerophyll forest on the sheltered mountain slopes above 300 m and Messmate herb-rich foothill forest in the lower sections of Broad Gully and Black Calf Creek; Superb Lyrebird; diverse mountain reptile and orchid assemblage and large population of the Elbow Orchid; rare representatives of mature/unlogged systems;
- Long-leaf Box–Red Stringybark box–stringybark woodland (between 250 and 350 m elevation); foothill vegetation inadequately reserved.

Site 104 Steels Creek–Watsons Creek Headwaters

- Map Reference:** 7922 562395 to 7922 542440 (Jehosaphat Creek); 7922 541342 to 7922 536385 (Watsons Creek). One minute lat/long grids include 37° 32' x 145° 20' to 145° 22', 37° 33' x 145° 20' to 145° 22', 37° 34' x 145° 20' to 145° 22' and 37° 35' x 145° 20' to 145° 21'.
- Location/Size:** Kinglake National Park between the Everard Trail/Cookson Hill track and the Yarra Glen–Mt Slide Road. Approximately 2000 ha.
- Municipality:** Shire of Nillumbik and Shire of Yarra Ranges (far eastern section).
- Land Tenure/Use:** Public: majority is national park (NRE). As for the Diamond Creek Headwaters site.
- Landforms:** Mountain and foothill. Elevation is 170–520 m (Jehosaphat Creek source).

Natural Heritage Values

Landscape. The foothills sections contain stands of riparian forest, herb-rich foothill forest, gully woodland, box–stringybark woodland and heathy woodland. Outside Kinglake NP and the Plenty River catchment, these are reserved together elsewhere in GM only in the Dandenong and Lerderderg Ranges. These areas contain some of the finest reserved stands of these habitats in Victoria. Elsewhere they have been subjected to widespread environmental modification (e.g. bushfires, land clearing/settlement, timber extraction and mining).

Much of the interior of the site is inaccessible. Remoteness has protected it from disturbances and settlement. The Jehosaphat and Watsons creeks are two of the most pristine examples of foothills stream catchments in GM. The latter is proposed to be contained in the Mountain Heath Ecological Reference Area (see site 103). The Jehosaphat Creek catchment, apart from alluvial mining during the gold rush (and the associated invasion of some Blackberry and Tutsan) along the lower sections of the creek, is in a natural condition down to where it leaves the national park (at 150 m elevation). No other lowland section of any perennial stream in GM is in such condition. For example, the Diamond and Arthurs creeks are substantially modified below elevations of 250 m to 300 m (where they leave the park).

Small stands of unlogged Mountain Ash wet forest (2.1) occur in the steep headwaters of the Jehosaphat and Full and Plenty creeks. Old-growth stands are disjunct in Victoria (e.g. headwaters of the Plenty River East Branch in the Disappointment Reference Area and the O'Shannassy Reservoir catchment). Jehosaphat Gully contains a diverse and rare assemblage of cool temperate ferns. The Jehosaphat was burnt in 1939 and the Full and Plenty was burnt in 1926. The 1962 bushfire swept the Steels Creek valley to the east and then the Diamond Creek valley to the west. The last major bushfire in one section of the Full and Plenty appears to have been in 1851.

The Full and Plenty Creek follows a sheltered south-eastern aspect. At 330 m elevation (above the crossing of the Yarra Glen–Mt Slide Road) the vegetation passes from Mountain Ash wet forest to Mountain Grey Gum damp riparian forest. Both types support a rainforest understorey dominated by Soft Tree-fern, Austral Mulberry and Musk Daisy-bush, climbers such as the Twining Silkpod, and rosette ferns.

Scientific and Educational Values

Rehabilitation and management. Kinglake NP. Friends of the Lyrebird.

Public interpretation. Jehosaphat Gully, Girraween and Jehosaphat Creek picnic areas and Chalmers Ridge, Jerusalem and Bundy Tracks (walking tracks).

HABITAT SIGNIFICANCE

Assessment: Very High—Category 2

Reference stands: Mountain Ash wet forest (2.1); Mountain Grey Gum damp riparian forest (3.1); Mountain Grey Gum damp sclerophyll forest (4.1); Messmate damp sclerophyll forest (4.2); Manna Gum riparian forest (5.3); Messmate herb-rich foothill forest (6.3); Broad-leaved Peppermint heathy forest (8.1); Long-leaf Box–Red Stringybark box–stringybark woodland (11.4)

Relatively intact and extensive stands: Red Stringybark herb-rich foothill forest (6.1); Mealy Stringybark heathy woodland (9.1); Messmate–Mountain Swamp Gum gully woodland (10.2)

Partially intact or small stands: Messmate–Green Scentbark heathy woodland (9.2)

Endangered species: Crimson Spider-orchid

Rare species: Netted Brake, Oval Fork-fern, Creeping Grevillea

Critical assemblages or populations: Strategic Habitat Link. Rare/disjunct ferns at Jehosaphat Gully; regionally endangered Butterfly Orchid.

FAUNAL SIGNIFICANCE: Site 104 Steels Creek–Watsons Creek Headwaters

Assessment: State—1 (B, C, E, F); Regional (B, C, D, E, F)F

Reference grids for the significance keys include:

104^a: 37° 32' x 145° 20'; Jehosaphat Gully/upper Jerusalem Track

104^b: 37° 33' x 145° 22'; Mt Slide Rd/goldmine, Full and Plenty Creek

104^c: 37° 34' x 145° 21'; lower Jerusalem Track/Old Kinglake Road

104^d: 37° 34' x 145° 22'; lower Jehosaphat Creek/Chalmers Ridge

104^e: 37° 35' x 145° 21'; lower Bundy Track/Brennan Avenue

A. Cited Zoological Significance

State. Kinglake NP site: Mansergh *et al.* (1989)

B. RARITY: Rare or Threatened Fauna

b. Vulnerable fauna

State. **104^b:** Eastern Horseshoe Bat

c. Rare fauna

State. **104^c:** Sooty Owl, Barking Owl, Powerful Owl, Brush-tailed Phascogale, Tree Goanna

State **104^d:** Brush-tailed Phascogale, Common Bent-wing Bat, Mountain Galaxias, Broad-finned Galaxias

State **104^a:** Sooty Owl (breeding), Powerful Owl, Brush-tailed Phascogale, Mountain Dragon

Regional. **104^e:** Brush-tailed Phascogale, Common Dunnart, Tree Goanna

Regional. **104^b:** Common Bent-wing Bat

C. DIVERSITY: Species/Assemblage Richness—point census/trapping

h. Bats

State. **104^a:** 8 species including Gould's Long-eared Bat, Eastern False Pipistrelle and Southern Forest Bat along upper Jerusalem Track in March 1988

Regional. **104^b:** 7 species including Gould's Long-eared Bat, Eastern False Pipistrelle, Southern Forest Bat, Eastern Horseshoe Bat and Common Bent-wing Bat at Full and Plenty Creek/Mt Slide Road in March 1988

i. Arboreal mammals

Regional. 104^a: 6 species including Mountain Brushtail Possum, Greater Glider, Sugar Glider and Feathertail Glider at Jehosaphat Gully in December 1986

j. Ground mammals

Regional. 104^b: 6 species including Brown Antechinus and Dusky Antechinus at Full and Plenty Creek/Mt Slide Road in March 1988

l. Reptiles

Regional. 104^b: 9 species including Tree Dragon, White's Skink, Metallic Skink, Eastern Three-lined Skink, Eastern Small-eyed Snake, White-lipped Snake and Eastern Brown Snake at Yarra Glen–Mt Slide Road north of Steels Creek on 27 December 1991; 6 species including Black Rock Skink, Weasel Skink, Coventry's Skink and Southern Grass Skink at Full and Plenty Creek on 27 December 1991

Regional. 104^a: 8 species including Mountain Dragon, Black Rock Skink, Spencer's Skink, Coventry's Skink, McCoy's Skink and Southern Grass Skink along upper Jerusalem Track in March 1988

Regional. 104^e: 6 species including Blotched Blue-tongued Lizard and Lowland Copperhead along lower Bundy Track in June 1993

m. Freshwater fish

Regional. 104^d: Short-finned Eel, Mountain Galaxias and Broad-finned Galaxias in Jehosaphat Creek at the Old Kinglake Road picnic area in June 1993

D. REPRESENTATIVENESS: Faunal Assemblages—reference grid survey

a. All native vertebrate fauna

Regional. 104^b: 91 species. **104^d:** 71 species. **104^c:** 68 species

Regional. 104^e: 68 species. **104^a:** 65 species

b. Native birds

Regional. 104^c: 58 species. **104^b:** 54 species. **104^d:** 52 species

Local. 104^e: 45 species. **104^a:** 33 species

c. Native mammals

Regional. 104^a: 19 species. **104^b:** 17 species. **104^e:** 13 species

Regional. 104^c: 10 species. **104^d:** 7 species

d. Herpetofauna

Regional. 104^b: 20 species. **104^a:** 13 species. **104^e:** 10 species. **104^d:** 9 species

e. Freshwater fish

Regional. 104^d: 3 species

f. Butterflies

Regional. 104^d: 28 species. **104^b:** 23 species

E. REPRESENTATIVENESS: Significant Species—reference grid survey

a. GM critical fauna (R1-R4 species)

State. 104^b: 26 species

Regional. 104^a: 17 species. **104^d:** 16 species

Local. 104^c: 12 species. **104^e:** 9 species

b. Regionally endangered fauna (R1 species)

Regional. 104^b: 2 species. Mammals: White-footed Dunnart, Eastern Horseshoe Bat
Regional. 104^{ac}: 1 species. Birds: Sooty Owl
Regional. 104^e: 1 species. Birds: Tawny-crowned Honeyeater
c. Regionally vulnerable fauna (R2 species)
State. 104^b: 8 species. Birds: Chestnut-rumped Heathwren, Lewin's Honeyeater, Satin Bowerbird. Mammals: Yellow-bellied Glider, Common Bent-wing Bat Reptiles: Metallic Skink. Butterflies: Eliena Skipper, Mountain Spotted Skipper
Regional. 104^e: 5 species. Birds: White-throated Nightjar, Hooded Robin. Mammals: Brush-tailed Phascogale, Common Dunnart. Reptiles: Tree Goanna
Regional. 104^d: 4 species. Mammals: Brush-tailed Phascogale, Common Bent-wing Bat. Fish: Broad-finned Galaxias. Butterflies: Bright Copper
Regional. 104^c: 3 species. Birds: White-throated Nightjar. Mammals: Brush-tailed Phascogale. Reptiles: Tree Goanna
Regional. 104^a: 2 species. Mammals: Brush-tailed Phascogale. Reptiles: Mountain Dragon
d. Regionally rare fauna (R3 species)
State. 104^b: 14 species. Birds: Large-billed Scrubwren, Pilotbird. Mammals: Dusky Antechinus, Gould's Long-eared Bat, Eastern False Pipistrelle. Reptiles: Black Rock Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink, Eastern Small-eyed Snake, White-lipped Snake Reptiles: Coventry's Skink. Butterflies: Kershaw's Brown, Fringed Blue
State. 104^a: 11 species. Birds: Large-billed Scrubwren, Pilotbird. Mammals: Mountain Brushtail Possum, Greater Glider, Feathertail Glider, Gould's Long-eared Bat, Eastern False Pipistrelle. Reptiles: Black Rock Skink, Spencer's Skink, Coventry's Skink, Southern Grass Skink
Regional. 104^d: 4 species. Birds: Pink Robin, Spotted Quail-thrush. Reptiles: White-lipped Snake. Butterflies: Common Silver Xenica
Local. 104^{ce}: 1 species. Birds: Spotted Quail-thrush
e. Regionally depleted fauna (R4 species)
Regional. 104^d: 8 species. Birds: Whistling Kite, Superb Lyrebird, Bassian Thrush, Eastern Whipbird. Mammals: Platypus. Reptiles: White's Skink. Fish: Mountain Galaxias. Butterflies: Flame Skipper
Regional. 104^c: 7 species. Birds: Barking Owl, Powerful Owl, Superb Lyrebird, Bassian Thrush, Eastern Whipbird. Reptiles: White's Skink. Fish: Mountain Galaxias
Regional. 104^a: 3 species. Birds: Powerful Owl, Superb Lyrebird, Eastern Whipbird
Regional. 104^b: 2 species. Birds: Australian King-Parrot. Butterflies: Spotted Brown
Regional. 104^e: 2 species. Birds: Superb Lyrebird, Bassian Thrush
f. Regionally restricted fauna (R5 species)
Regional. 104^b: 10 species. Birds: Painted Button-quail, Brush Bronzewing, Brush Cuckoo, Rose Robin, Olive Whistler, Red-browed Treecreeper. Reptiles: McCoy's Skink. Butterflies: Phigalia Skipper, Bank's Brown, Sword-grass Brown
Local. 104^d: 7 species. Birds: Painted Button-quail, Olive Whistler, Red-browed Treecreeper. Frogs: Southern Toadlet. Butterflies: Spotted Skipper, Phigalia Skipper, Dark Purple Azure
Local. 104^a: 4 species. Birds: Brush Bronzewing, Rose Robin, Red-browed Treecreeper. Reptiles: McCoy's Skink

Local. 104^e: 4 species. **Birds:** Painted Button-quail, Royal Spoonbill, White-winged Chough. **Mammals:** Koala

Local. 104^c: 3 species. **Birds:** Brush Cuckoo, White-winged Chough. **Mammals:** Koala

g. Nesting birds of prey/parrots

Regional. 104^a: Sooty Owl. **104^b:** Yellow-tailed Black-Cockatoo, Australian King-Parrot

Regional. 104^c: Yellow-tailed Black-Cockatoo

F. POPULATION DENSITY: Viability and Abundance—point census

b. Rare or threatened fauna

State. 104^b: vulnerable species; 12 Eastern Horseshoe Bats at Mt Slide Road mine on 1 June 1989

g. Rare/restricted colonial fauna

State. 104^b: 400 Common Bent-wing Bats at Mt Slide Road mine on 1 June 1989; 325 Common Bent-wing Bats on 31 August 1988

i. Bat trapping rate

State. 104^a: Trap-night average of 32 along upper Jerusalem Track in March 1988

m. Regionally rare fauna (R3 species)

Regional. 104^a: 7 Gould's Long-eared Bats along upper Jerusalem Track in March 1988; 6 Greater Gliders at Jehosaphat Gully in December 1986

n. Regionally depleted fauna (R4 species)

Regional. 104^d: 18 Mountain Galaxias in Jehosaphat Creek at picnic area in June 1993

Outlook

Current park management is maintaining faunal values. Perimeter disturbances are increasing with farming intensification between Kinglake and Mt Slide, bushblock subdivision at Steels Creek, and escalating horse riding. Introduced predators, particularly dogs, are an increasing threat.

FAUNA

The interior of the Watsons Creek headwaters block was not surveyed during the fauna study due to access and time constraints. This is the most remote and inaccessible section of NEM.

Rare or Threatened Fauna

Bb 104^b: Eastern Horseshoe Bat at Mt Slide Road gold mine. One was trapped at the mine entrance on 21 March 1988. On 1 June 1989, 12 were located in the upper level of the mine. This level was warm due to its sunnier aspect and small entrance diameter. The species, listed vulnerable in Victoria, was recorded in only three other locations in NEM including the One Tree Hill mine (site 80).

Bc 104^a: Sooty Owl breeding in old growth forest of Jehosaphat Gully. They breed in the secluded headwaters of the Jehosaphat Creek. Birds have been heard as far downstream as the Old Kinglake Road, about 1 km west of Steels Creek (Leigh Ahern pers. comm.). Only two other pairs are known in NEM (Plenty River headwaters and Diamond Creek headwaters). Jehosaphat Gully supports old-growth Mountain Ash wet forest (2.1) and Mountain Grey Gum riparian damp sclerophyll forest (3.1). Optimum habitat for the Sooty Owl, which require large tree hollows, is large patches of old-growth mixed species forest (David Milledge pers. comm.). Trunk hollows of the size required by the Sooty Owl probably take upwards of 150 years to develop.

The breeding season commences in early spring and is accompanied by frequent calling. At this time the male and female birds trill and twitter constantly when together. The more familiar descending whistle

(sounding like a falling bomb) is uttered away from the nest as a contact and feeding call. A female lays a clutch of two eggs annually, usually rearing one young. The juvenile remains in the breeding territory with the adults for three to six months after fledging.

Sooty Owls hunt by sound when in flight, but also scan from a mid-strata perch. Their broad, rounded wings make them rather manoeuvrable and enable them to move stealthily along a stream beneath the rainforest gallery in search of their main prey (Dusky Antechinus and Bush Rats). They also frequently take Sugar Gliders and Common Ringtail Possums from the canopy. The Sooty Owl's requirement of a large home range and dependence on large hollows for nest sites and provision of prey species makes them vulnerable to logging, particularly clearfelling operations.

The Jehosaphat Gully pair was located in November 1987, when a bird performed a single descending whistle at dusk. A silent, shadowy silhouette passed overhead and flew some distance. Then a series of trills and twitters uttered by two birds commenced, indicating the nest-tree was close-by.

The female was detected under spotlight on a perch adjacent to a hollow some 40 m above the ground in the trunk of a giant Mountain Ash stag. It is considerably larger than the male and was grasping what was possibly a Bush Rat in its talons. The begging call of a young bird could be heard from inside the hollow.

Bc 104^{acde}: Brush-tailed Phascogale. The low rate of bushland fragmentation buffers the Brush-tailed Phascogale from introduced predators. The site provides almost 20% of all sightings for GM of this rare species. They were recorded most frequently in box-stringybark woodland (11.4) and herb-rich foothill forest (6.1). They were also recorded in damp sclerophyll forest (4.1) at higher elevation.

The nest of leaves and shredded bark is placed in a hollow limb or spout of a eucalypt. Females occupy a small territory of 4–5 ha during the breeding season of July to December (Strahan 1988). From three to six young have been recorded and lactation occurs over spring when food for the mother is abundant. The juveniles, which are independent at seven months, share the nest with their mother until the commencement of the next breeding season. Females may live for two or more years.

Males are solitary and become highly mobile and aggressive towards other males during the breeding season as they search for mates. They live for less than a year, dying from stress-related disorders in winter soon after the brief and highly synchronised mating season. None are free-living in the population during spring. Given the low chance of survival of small scansorial mammals (utilising trees and the ground, similar to the Brown Antechinus) to breed in a second year, evolution has invested maximised reproductive effort in the males' first year, at the expense of longevity. In the predictable seasonal environment of south-eastern Australia females can comfortably rear young on their own during spring. In the absence of adult males, competition for food and hollows is avoided.

Mostly arboreal, the Brush-tailed Phascogale takes invertebrates (e.g. large beetles, spiders and centipedes) from under bark, branch crevices and foliage, nesting birds and their eggs (occasionally poultry) and small mammals. They remain stationary for periods (even in a downwards direction on a vertical trunk) while foraging, tapping the bark with their paw and listening for movement of prey, before tearing away the bark or making a swift, agile leap. They forage on the ground at the base of trees amongst fallen logs and bark where they have been caught in Elliott traps.

Brush-tailed Phascogales have declined dramatically in recent decades near Melbourne due to habitat clearing and fragmentation, human disturbance and predation from cats and foxes. Long-term viability of these populations is poor. Once widespread in Gippsland, they have not been recorded there since 1969 (Norris *et al.* 1983, Lumsden 1991). As well as the effects of clearing and predation, their decline may be attributable to disturbance associated with logging and grazing.

Site connectivity is critical for the phascogale and is why the Steels Creek–Watsons Creek Headwaters site is a stronghold. In the lowlands, habitat links for dispersal of ground and arboreal fauna are being severely constricted by roadway, residential and farmlot development. Maintenance of functional corridors to

lowland bushland areas through the proposed Yarra–Kingslake Conservation Link may be critical for survival of the phascogale nearer Melbourne. Locally, it is desirable that wandering domestic pets should be restrained and feral predators culled. A surprising number, mostly males, have been recorded as road-kills during their autumn dispersal.

- Bc* **104^{ce}: Brush-tailed Phascogale and Common Dunnart in the Old Kingslake Road/lower Bundy Track area.** Two local residents forwarded information (Leigh Ahern of **104^c** and Jenny Barnett of **104^e**). Both recorded the Brush-tailed Phascogale. The Common Dunnart was trapped in Red Stringybark herb-rich foothill forest (6.1) near a house adjoining the lower Bundy Track.
- Bc* **104^a: Mountain Dragon at upper Jerusalem Track.** Eight species including the Mountain Dragon, Black Rock Skink, Spencer’s Skink, Coventry’s Skink, McCoy’s Skink and Southern Grass Skink were recorded during a 2-hour herpetofauna search along upper Jerusalem Track and Pinchgut Creek on 21 March 1988. The Mountain Dragon had been recorded nearby at Mt Jerusalem in 1976 (Hutchinson 1979). Two were recorded in Mountain Grey Gum damp sclerophyll forest (4.1) along Jerusalem Track about 500 m from the Heidelberg–Kingslake Road.
- Bc* **104^{ce}: Tree Goanna.** Often seen in habitats 6.1 and 11.4 the Old Kingslake Road/lower Bundy Track area (Leigh Ahern and Jenny Barnett pers. comm.).
- Bc* **104^d: Broad-finned Galaxias and Mountain Galaxias in Jehosaphat Creek.** Both were present in the Jehosaphat Creek near the Old Kingslake Road picnic area on 3 June 1993. The Broad-finned Galaxias (superficially similar to the Brown Trout) was seen amongst the cobble riffles. Eighteen Mountain Galaxias were counted in a 300 m section of the creek. Both species of galaxias would breed in Jehosaphat Creek. Broad-finned Galaxias are able to ascend to the headwater pools of ephemeral streams when they commence flowing in late autumn. This creek appears to be important for galaxias and should be electrofished in the future. A Platypus was also observed.

Critical Assemblages or Populations

- Ch/Fi* **104^a: High bat diversity and population density on the upper Jerusalem Track.** Eight species of mountain forest bats including the Gould’s Long-eared Bat (7 individuals), Eastern False Pipistrelle and Southern Forest Bat were trapped under Mountain Grey Gum damp sclerophyll forest (4.1) along Jerusalem Track near the Heidelberg–Kingslake Road between 21 and 23 March 1988. This effort returned an impressive average of 32 bats per trap-night.
- Fb/Fg* **104^b: Largest Eastern Horseshoe Bat and second largest Common Bent-wing Bat roost in GM at Mt Slide Road mine.** A roosting colony of 12 vulnerable Eastern Horseshoe Bats was present in the upper level of the mine on 1 June 1989 (see *Bb*) The colony is the largest located west of Bairnsdale in southern Victoria. A roosting colony of 400 restricted/colonial Common Bent-wing Bats was also observed in the lower level of the mine. One had been banded near Lake Eildon. Approximately 325 had been previously recorded in the lower level on 31 August 1988. This level is cool due to surface water. On 21 March 1988, 18 bent-wing bats (15 males and 3 females) were captured in a harp trap placed in front of the lower entrance. The Mt Slide Road mine supports the second largest cave-bat colony known in Greater Melbourne and is likely to be a key roosting site in the movements of these species (see One Tree Hill site 80).

Other Significant Fauna

Birds

- Ec* **104^b: Chestnut-rumped Heathwren at Mt Slide Road.** Several were recorded in a Hairpin Banksia amongst Broad-leaved Peppermint heathy forest (8.1) on 28 December 1991. This species was more common in the foothills of the Kingslake Ranges in the decade following the 1962 bushfires, as it recolonises the early stages of post-fire regrowth.

Eb/Ec **104^e: Tawny-crowned Honeyeater and Hooded Robin at lower Bundy Track.** Wintering birds were seen along Bundy Track on 3 June 1993. Several Tawny-crowned Honeyeaters were feeding in the flowering Silver Banksia, Hairpin Banksia, Common Heath, Cat's Claw Grevillea and Common Correa in Broad-leaved Peppermint heathy forest (8.1) on the north-facing slopes above the Old Kinglake Road. The honeyeater undertakes extensive movements outside the breeding season. Breeding grounds near Melbourne appear restricted to coastal heaths. Two Hooded Robins were seen hawking insects over the canopy of the stunted heathy forest along the Bundy Track ridgeline. On sunny, calm days in winter flying insects rise from the surrounding valleys and congregate on the narrow ridgelines. The winter movement of the Hooded Robin into the uplands is the opposite of the seasonal movement of the Flame Robin. The latter breeds in the uplands in summer and moves to the lowlands for winter.

Ec **104^b: Lewin's Honeyeater, Satin Bowerbird and other mountain birds of Full and Plenty Creek.** The perennial Full and Plenty Creek contains a diverse mountain gully avifauna. This includes the Brush Cuckoo, Superb Lyrebird, Pilotbird, Lewin's Honeyeater and Satin Bowerbird. The mountain forest trees (Messmate and Mountain Grey Gum; 3.1, 4.2) support breeding Australian King-Parrots.

104^c: Bird list for the Old Kinglake Road. Data has been kindly provided by Leigh Ahern of Steels Creek. The surrounding vegetation includes herb-rich foothill forest (6.1) on the upper sheltered slopes, Messmate herb-rich foothill forest (6.3) on the lower sheltered slopes and Messmate–Mountain Swamp Gum gully woodland (10.2) in the gullies and Jerusalem Creek. Fifty-eight native species were recorded. A summary of significant sightings includes the Barking Owl and Powerful Owl (both occasionally heard/seen), Sooty Owl (occasionally heard), Yellow-tailed Black-Cockatoo (breeding), Superb Lyrebird, Spotted Quail-thrush and White-throated Nightjar.

104^e: Bird list for the lower Bundy Track. Data has been kindly provided by Jenny Barnett of Steels Creek. The surrounding vegetation is similar to that of the preceding but includes Long-leaf Box–Red Stringybark box–stringybark woodland (11.4) on the lower exposed slopes and Broad-leaved Peppermint heathy forest (8.1) on the ridges. Thirty-five native species were recorded. A summary of significant sightings includes the Royal Spoonbill (at a dam), Spotted Quail-thrush, White-throated Nightjar (breeding summer migrant) and Superb Lyrebird.

Mammals

Eb **104^b: White-footed Dunnart at Mt Slide Road.** One was taken in an Elliott trap set in Broad-leaved Peppermint heathy forest (8.1), about 4 km north of Steels Creek along the Mt Slide Road on 27 December 1991.

Ec **104^b: Yellow-bellied Glider at Full and Plenty Creek.** One was present in Mountain Grey Gum damp riparian forest (3.1) downstream of the Full and Plenty Creek crossing of the Mt Slide Road on 21 May 1988. It had responded to a call from a playback tape. Three of the six other sightings made in NEM during the survey were along the Kinglake NP–Watsons Creek–Yarra River–Warrandyte SP conservation link. This area is of critical importance to the Yellow-bellied Glider in NEM (see Watsons Creek Upper Reaches–Yarra Ridge site).

Ed **104^b: Eastern False Pipistrelle and other mountain forest bats of Mt Slide Road mine area.** The nearby Full and Plenty Creek supports Mountain Grey Gum damp riparian forest (3.1). The valley of the creek and that of the Mt Slide Road mine supports Messmate damp sclerophyll forest (4.2). Seven species of bats were trapped between 21 and 23 March 1988. The Gould's Long-eared Bat, Eastern False Pipistrelle and Southern Forest Bat were trapped in the valley of the mine. The Eastern Horseshoe Bat and Common Bent-wing Bat were trapped at the entrance of the mine.

Ed **104^a: Greater Glider and other arboreal mammals of Jehosaphat Gully.** Six Greater Gliders were seen in 60 minutes' spotlighting of wet forest (2.1) at Jehosaphat Gully on 17 December 1986. Other species seen on that occasion included the Mountain Brushtail Possum, Sugar Glider and Feathertail Glider.

Ed **104^b: Dusky Antechinus and other ground mammals of Full and Plenty Creek.** Mammal trapping under Messmate damp sclerophyll forest (4.2) near the Mt Slide Road mine conducted between 21 and 23 March 1988, recorded the Bush Rat, Dusky Antechinus and Brown Antechinus. Each species was represented by multiple trappings.

Unconfirmed sightings of the Spot-tailed Quoll. There are unconfirmed reports in the headwaters of Watsons Creek, south-east of Mt Everard. The presence of the quoll is plausible, given that they have been observed in the Diamond Creek headwaters and Chadds Creek headwaters of Kinglake NP. The Spot-tailed Quoll would be unlikely to occur elsewhere in NEM.

Reptiles

Ec **104^b: Metallic Skink at Mt Slide Road.** Broad-leaved Peppermint heathy forest (8.1) by the Yarra Glen–Mt Slide Road supports the only known population of the Metallic Skink in NEM. Their nearest known occurrence is above New Chum Creek, about 10 km to the east.

Ed **104^b: Black Rock Skink and other reptiles of the Yarra Glen Mt Slide Road.** Fourteen species were recorded from intensive herpetofauna searches on 27/28 December 1991. Six species were yielded from the damp riparian and damp sclerophyll forest (3.1, 4.1, 4.2) of the mountains (300–500 m elevation) at Full and Plenty Creek. These included the Black Rock Skink, Southern Water Skink, Coventry's Skink, Weasel Skink and Southern Grass Skink. Nine species were yielded from herb-rich foothill and heathy forests (6.1, 6.3, 8.1) of the foothills (200–350 m elevation) closer to Steels Creek. These included the Tree Dragon, Blotched Blue-tongued Lizard, Metallic Skink, Eastern Three-lined Skink, White's Skink (Elliott trap set in heathy forest), Eastern Brown Snake, White-lipped Snake and Eastern Small-eyed Snake. The Garden Skink was common to both areas.

104^c: Reptiles of lower Bundy Track. Six species were recorded from a 60-minute herpetofauna search along lower Bundy Track on 3 June 1993. These included a Tree Dragon seen sunning from a hole at the base of a tree stump on the ridgeline, a Weasel Skink, Southern Water Skink and Lowland Copperhead under logs on the grassy sheltered slopes (Messmate herb-rich foothill forest; 6.3) and one Blotched Blue-tongued Lizard and four Garden Skinks under flat rocks on the exposed slopes (8.1).

Butterflies

Ec **104^b: Mountain Spotted Skipper.** Observed in damp riparian forest (8.1) along Full and Plenty Creek on 8 December 1992. The gully contains Red-fruit Saw-sedge which is the probable larval food-plant. The skipper also historically occurred in the lowlands (e.g. Heathmont–Bayswater) where it is locally extinct due to urban development.

Ed **104^b: Fringed Blue.** This was observed in heathy forest above the Yarra Glen–Mt Slide Road on 28 December 1991. The larvae feed on unopened buds and green seed-pods of shrub peas. The Gorse Bitter-pea, Large-leaf Bush-pea, Rough Bush-pea and Golden Bush-pea were locally abundant. They have been recorded on Showy Parrot-pea at Research in the early 1960s (Fabian Douglas pers. comm.). The Fringed Blue has been located in only two other areas in NEM in recent years but is probably more widespread. Like many Lycaenids, populations appear to be mobile. They have an ability to appear and disappear from areas, being possibly adapted to successional regrowth after fire.

104^d: Lower Jehosaphat Creek/Chalmers Ridge. Twenty-eight species recorded. Significant species: Donnysa Skipper, Spotted Skipper, Bright Shield Skipper, Flame Skipper, Phigalia Skipper, Phigalioides Skipper, Symmomus Skipper, Cyril's Brown (adult on flowers of Snow Daisy-bush at Chalmers Ridge on 17 October 1992), Common Silver Xenica (adult at the Old Kinglake Road picnic area on 21 March 1993; Michael Braby pers. comm.), Dark Purple Azure, Bright Copper (Old Kinglake Road picnic area; Michael Braby pers. comm.) and Common Dusky Blue.

104^b: Mt Slide Road. Twenty-three species recorded. Significant species: Donnysa Skipper, Mountain Spotted Skipper, Bright Shield Skipper, Anderson's Skipper, Eliena Skipper (adult feeding in flowering

Sweet Bursaria in gully woodland on 10 February 1993), Phigalia Skipper, Symmomus Skipper, Cyril's Brown, Bank's Brown, Spotted Brown, Kershaw's Brown, Sword-grass Brown, Olane Azure and Fringed Blue.

MANAGEMENT

Threatening Processes	Conservation Measures
Regional Habitat Link Strategy	
Habitat connectivity. Strategic Habitat Link to sites 79, 81 and 103.	
Strategic Habitat Link. Private land areas containing significant stands of habitat adjoining Kinglake NP should be zoned for conservation if the viability of faunal populations in the park is to be maintained.	
<p>Decline of the Yellow-bellied Glider due to loss of nest-sites from timber harvesting. Yellow-bellied Gliders are highly sensitive to clearing and logging (Henry & Craig 1984). They are now rare and localised in NEM. A population exists in old-growth mountain forest at Full and Plenty Creek, an area dominated by trees which have reached maximum vertical and horizontal expansion. Animals seen along Watsons Creek and near the Yarra may have dispersed from this centre. Yellow-bellied Gliders maintain large, permanent home ranges and have specialised foraging requirements dependent on fluctuating and broadly dispersed food sources (needing contiguous forests to move around). The population in Kinglake NP would be dependent on contiguous habitat links to external populations further east in the Central Highlands.</p> <p>The glider is an important prey of the rare Sooty Owl. Nest hollows of the dimensions required by both species take over 150 years to mature. Intensive harvesting operations occur throughout much of the range of the glider in Victoria. Clearfelling of 20–40 ha coupes on cutting-cycle rotations of less than 80 years has locally eliminated them from large areas of ash forest in Toolangi State Forest (David Milledge pers. comm.). No extensive unlogged stands of old-growth forest remain in Toolangi State Forest and there are few areas remaining with high densities of old trees. Environmental prescriptions placed on logging require stream retention strips in old-growth forest, but these are of debatably insufficient width and connectivity to support resident populations of the glider. The stag trees are often incinerated by post harvesting operations or collapse on exposure to wind (Smith & Lindemayer 1988).</p>	<p>Mountain Heath Ecological Reference Area. The ERA contains the headwaters of Watsons Creek, Mt Everard, Mt Beggary and Broad Gully. It is contained in the hinterland of Kinglake NP. The managing authority is the Department of Natural Resources and Environment (see site 103).</p> <p>Strengthen Strategic Habitat Link. The site has a long interface with settled foothill areas and provides a vital, contiguous mountain forest link for rare fauna such as the Sooty Owl and Yellow-bellied Glider. The site brings into contact with settlement these seldom observed species. As well as its intrinsic biological significance, it has high educational, recreational and aesthetic value to the public.</p> <p>Placental predator control, especially cats and dogs. This requires rigid enforcement in public land areas. A system of restraint of wandering pets to their properties should be developed.</p> <p>Implementation of Native Vegetation Clearance Controls and rezoning of private land. Adjacent land owners to the national park should be encouraged to protect native vegetation. Significant bushland adjacent to the park must be protected, particularly large, old trees containing hollows, and stream and gully vegetation. Private land areas containing significant stands of habitat in catchments upstream of Kinglake NP and adjoining in the Steels Creek area must be rezoned Conservation if the viability of faunal populations in the park is to be maintained.</p>
Regional Hydrological Strategy	

	<p>Weed control and visitor-use plan for Jehosaphat Creek. Blackberry and Tutsan control along the Jehosaphat Creek near Old Kinglake Road is a priority as this area is not yet seriously overtaken by weeds. Signs are apparent of increases in weeds and human disturbance along the creek. The Kinglake NP management plan addresses containment of weeds and other human-use issues such as bank disturbance. It proposes to restrict horse riding from the Jerusalem Track and divert this to the Old Kinglake Road through its closure to vehicle traffic. The disturbance arises from both the local community at Steels Creek (e.g. horse riders) and from visitors to the adjacent picnic area (e.g. littering and bank erosion).</p>
Other Issues	
	<p>Grills at the entrances of Mt Slide Road Mine. Grills to prevent human visitation need to be erected. These must be of proper design so as not to restrict access for bats. Unauthorised persons should not enter the mine. Monitoring of the cave-bat population should be undertaken.</p>
<p>Disturbance from humans at the Mt Slide Road Mine. The mine has a concealed, water-filled vertical shaft. A sign outside its entrance indicates that the air may contain poisonous gases and harmful air-borne bacteria. Cave-ins have occurred.</p>	<p>Incorporation of further sections of Toolangi State Forest into Kinglake NP. Areas not used for hardwood production (e.g. Dixon and Paul Creek headwaters) should be incorporated into Kinglake NP to ensure long-term protection/viability of the faunal corridor to the east. These areas are presently undergoing degradation from trail-bike and horse riders.</p>
	<p>Require land protection works at Chalmers Ridge. Degradation processes such as soil erosion due to past gold mining, rabbit and vehicle activities have occurred in the section of the park north of Steels Creek. Disturbed sections should be restored by land protection activities.</p>

Planning Recommendations

Mountain Heath Ecological Reference Area: Broad Gully–Watsons Creek headwaters. The headwater catchment of Watsons Creek, Mt Everard, Mt Beggary and Broad Gully form the proposed Mountain Heath Ecological Reference Area. The ERA requires restricted public access conditions and nature conservation of all native habitat to be the principal planning/land-use priority. The ERA contains specific conservation and research oriented guidelines (in accordance with the Regional Habitat Link and Hydrological Strategies). An ERA buffer zone is provided by surrounding land in Kinglake NP (see site 103).

Appendix 1.1 Habitat Types of NEM

Vegetation community	Sub-community		Character species	Conservation status		
	No.	Dom. canopy		VIC	GM	NEM
Cool Temperate Rainforest	1.1	Southern Sassafras, Myrtle Beech	Soft Tree-fern, Blackwood, Blanket-leaf	Cat 2	Disjunct	Occurrence: localised; Threats: low; Reservation: adequate
Wet Forest	2.1	Mountain Ash	Musk Daisy-bush, Bootlace Bush, Hazel Pomaderris	Cat 2	Depleted	Occurrence: restricted; Threats: moderate; Reservation: adequate
Damp Riparian Forest	3.1	Mountain Grey Gum	Soft Tree-fern, Blackwood, Austral Mulberry	Cat 3	Secure	Occurrence: restricted; Threats: low; Reservation: adequate
Damp Sclerophyll Forest	4.1	Mountain Grey Gum	Elderberry Panax, Tree Everlasting, Prickly Bush-pea	Cat 3	Secure	Occurrence: restricted; Threats: moderate; Reservation: adequate
Riparian Forest	4.2	Messmate, Narrow-leaf Peppermint	Forest Wire-grass, Narrow-leaf Wattle, Blackwood	Cat 3	Secure	Occurrence: widespread; Threats: moderate; Reservation: adequate
	5.1	Manna Gum	Silver Wattle, Cluster Pomaderris, Prickly Currant-bush	Cat 1	Depleted	Occurrence: restricted; Threats: high; Reservation: adequate
	5.2	Manna Gum	Austral Bracken, Silver Wattle, Burgan	Cat 1	Depleted	Occurrence: restricted; Threats: high; Reservation: inadequate
Herb-rich Foothill Forest	5.3	Manna Gum	Silver Wattle, Mountain Tea-tree, Hazel Pomaderris	Cat 1	Depleted	Occurrence: restricted; Threats: high; Reservation: inadequate
	6.1	Red Stringybark	Common Maiden-hair, Thatch Saw-sedge, Narrow-leaf Bitter-pea	Cat 3	Depleted	Occurrence: widespread; Threats: moderate; Reservation: inadequate
	6.2	Narrow-leaf Peppermint	Common T/sock-grass, Black Wattle, Sweet Bursaria	Cat 3	Depleted	Occurrence: restricted; Threats: moderate; Reservation: inadequate
Riverine Forest	6.3	Messmate, Narrow-leaf Peppermint	Common Cassinia, Handsome Flat-pea, Blackwood	Cat 3	Secure	Occurrence: widespread; Threats: moderate; Reservation: adequate
	7.1	River Red Gum	Rush Sedge, Blackwood, Tree Violet	Cat 2	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
	8.1	Broad-leaved Peppermint	Silvertop Wa/by-grass, Gorse Bitter-pea, Rosy Baeckea	Cat 3	Secure	Occurrence: restricted; Threats: low; Reservation: adequate
Heathy Woodland	9.1	Mealy Stringybark	Small Grass-tree, Small-leaf Parrot-pea, Woolly Wattle	Cat 3	Threat'd	Occurrence: restricted; Threats: moderate; Reservation: inadequate
	9.2	Messmate, Green Scentbark	Thatch Saw-sedge, Foest Wire-grass, Prickly Tea-tree	Cat 3	Threat'd	Occurrence: localised; Threats: moderate; Reservation: inadequate
Gully Woodland	10.1	Manna Gum	Thatch Saw-sedge, Black Wattle, Burgan	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	10.2	Messmate	Thatch Saw-sedge, Slender Tussock-grass, Small-leaf Glycine	Cat 1	Depleted	Occurrence: restricted; Threats: moderate; Reservation: adequate
	10.3	Swamp Gum	Spiny-head Mat-rush, Common Tussock-grass, Blackwood	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Box - Stringybark Woodland	11.1	Red Box, Red Stringybark	Silvertop Wallaby-grass, Dogwood, Golden Wattle	Cat 3	Depleted	Occurrence: widespread; Threats: moderate; Reservation: inadequate
	11.2	Yellow Box, Red Stringybark	Kangaroo Grass, Gold-dust Wattle, Golden Wattle	Cat 3	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	11.3	Red Stringybark, Red Box	Kangaroo Grass, Narrow-leaf Bitter-pea, Hedge Wattle	Cat 3	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	11.4	Long-leaf Box, Red Stringybark	Silvertop Wa/by-grass, Grey Tussock-grass, Woolly Wattle	Cat 3	Depleted	Occurrence: restricted; Threats: high; Reservation: adequate
Box - Ironbark Woodland	12.1	Red Ironbark	Silvertop Wallaby-grass, Grey Tussock-grass, Dogwood	Cat 3	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	12.2	Red Ironbark, Yellow Gum	Grey Everlasting, Golden Wattle, Wedge-leaf Hop-bush	Cat 3	Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
	12.3	Yellow Gum, Red Box	Cut-leaf Daisy, Golden Wattle, Burgan	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
Escarpment Woodland	13.1	Long-leaf Box, Manna Gum	Austral Bracken, Common Tussock-grass, Sweet Bursaria	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	13.2	Yellow Box	Kangaroo Grass, Black Wattle, Burgan	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	13.3	Red Box	Golden Wattle, Burgan, Prunus Pomaderris	Cat 3	Depleted	Occurrence: restricted; Threats: moderate; Reservation: adequate
Grassy Woodland	14.1	River Red Gum	Weeping Grass, Kangaroo Grass, Tree Violet	Cat 1	Threat'd	Occurrence: widespread; Threats: high; Reservation: inadequate
	14.2	Yellow Box, Hill Manna Gum	Black Wattle, Common Tussock-grass, Kangaroo Grass	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	14.3	River Red Gum	Weeping Grass, Kangaroo Grass, Black Wattle	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	14.5	Blakely's Red Gum	Kangaroo Grass, Kidney-weed, Broad-leaf Stinkweed	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	14.6	Yellow Box, Candlebark	Kangaroo Grass, Black Wattle, Hedge Wattle	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	14.7	Snow Gum	Velvet Tussock-grass, Common Cassinia, Black Wattle	Cat 1	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
Sand-plain Woodland	14.8	Grey Box	Common Everlasting, Golden Wattle, Tree Bursaria	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	15.1	Hill Manna Gum	Austral Bracken, Weeping Grass, Black Wattle	Cat 1	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
Floodplain Riparian Woodland	15.2	Burgan	Narrow Rock Fern, Common Love-grass, Kneed Wallaby-grass	Cat 1	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
	16.1	River Red Gum	Silver Wattle, Swamp Paperbark, Slender Knotweed	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	16.2	River Red Gum	Sword Tussock-grass, Silver Wattle, Tree Violet	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	16.3	River Red Gum	Weeping Grass, Burgan, Tree Violet	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate

Appendix 1.1 Habitat Types of NEM

Biophysical zone	Landform	Geology	Soil	Rainfall (mm)	Elev'n (m)
HR	mountain stream, sheltered mountain gully	Devonian granodiorite, Devonian siltstone	brown gradational, red gradational	1200-1300	550-720
HR, KR	mountain plateau/ slope/ gully/ valley	Silurian sandstone, Devonian granodiorite, Devonian siltstone	red gradational, brown gradational	1000-1300	350-794
nuh, HR KR	mountain stream	Quaternary alluvium	brown gradational	800-1000	250-600
puh, HR, KR	mountain spur/slope, mountain plateau	Silurian sandstone, Devonian granodiorite, Devonian siltstone	red gradational, yellow gradational	800-1000	450-650
ylh, nuh, puh, HR, KR	sheltered mountain slope, mountain gully/valley	Silurian sandstone, Devonian granodiorite, Devonian siltstone	red gradational, yellow gradational, red duplex	800-1100	150-650
ylap YLH	foothill riverbank	Quaternary alluvium	yellow duplex, yellow gradational, uniform sandy loam	680-800	15-70
ylap, puap, plh, YLH, NLH, nuh	foothill floodplain terrace	Quaternary alluvium	yellow duplex, yellow gradational	680-780	20-180
ylap, PUAP, PLH, YLH, NLH, NUH, PUH	foothill stream/gully, floodplain	Quaternary alluvium	yellow duplex, yellow gradational	660-800	20-300
puap, plh, YLH, NLH, NUH, puh, hr kr	sheltered hill-slope, foothill valley/gully	Silurian mud/sandstone, Devonian siltstone, Quaternary colluvium	yellow duplex, yellow gradational, red duplex	660-780	60-300
plh, YLH, NLH, nuh	shelt/d stream escarpment	Silurian mud/sandstone, Quaternary alluvium	yellow duplex, yellow gradational	660-800	40-250
ylh, nlh, NUH, puh, HR, KR	mountain slope/valley, sheltered hill-slope	Silurian mud/sandstone, Devonian siltstone	yellow duplex, yellow gradational, red duplex	750-850	80-400
puap	riverine floodplain	Quaternary alluvial	yellow duplex, black uniform clay	680-700	180-200
nuh, puh, HR, KR	exposed mountain slope, mountain ridge/spur	Silurian sandstone, Devonian siltstone	stony gradational	700-800	240-500
nuh, HR, KR	exposed hill-slope	Silurian mud/sandstone, Devonian siltstone	red duplex, stony gradational	700-750	240-350
nuh KR	foothill valley/gully	Silurian sandstone, Devonian siltstone	red duplex, yellow gradational	720-740	200-250
PLH, YLH, NLH, NUH puh	foothill creek/gully	Quaternary alluvium	yellow duplex, yellow gradational	680-750	25-250
nlh, ylh, NUH, puh, HR, KR	sheltered valley/gully, creek floodplain	Quaternary alluvium	yellow duplex, yellow gradational	720-800	100-300
ylap, puap, PLH, YLH, NLH, nuh, puh	sheltered valley/gully	Quaternary alluvium, Quaternary colluvium	yellow duplex, yellow gradational	640-700	40-180
PLH, YLH, NLH, NUH, kr	hill-crest, exposed hill-slope	Silurian mudstone, Devonian siltstone	stony gradational	640-760	60-300
ylap, puap, PLH, ylh, NLH, nuh, PUH	hill-crest, exposed hill-slope, river spur	Silurian sandstone, Devonian siltstone	stony gradational	640-700	60-240
plh, ylh, NLH	exposed valley	Silurian mudstone	yellow duplex	640-700	80-160
NUH, PUH, HR, KR	hill-crest ridge, exposed hill-slope	Silurian sandstone, Devonian siltstone	stony gradational	700-780	200-350
NLH, YLH	hill-crest, exposed hill-slope	Silurian mudstone, Silurian sandstone	stony gradational	700-780	140-200
PLH, NLH	hill-crest, exposed hill-slope, river spur/ escarpment	Silurian mudstone	stony gradational	660-700	120-180
PLH	river spur/escarpment, hill-crest	Silurian sandstone	stony gradational	660-700	20-140
YLAP, PLH, ylh	shelt/d river escarpment	Silurian sandstone, High level alluvium	yellow duplex	660-700	30-120
ylap, PLH, YLH	Exposed river escarpment, river bluff/spur	Silurian sandstone, Tertiary sand-plain, High level alluvium	yellow duplex, stony gradational	660-700	30-90
PLH, YLH	Exposed river escarpment, river bluff/spur	Silurian mudstone, High level alluvium	stony gradational	660-760	40-160
muvp, MLVP, PLVP, ylap, puap, plh	gilgai plain, stony plain	Quaternary volcanics	grey-black duplex	600-660	30-240
muvp, plvp, PLH, ylh	volcanic capping, volcanic cone, volcanic escarpment	Tertiary volcanics, Quaternary volcanics	black uniform clay, grey-black duplex, red gradational	620-700	100-420
mlvp, plvp, YLAP, PUAP, plh, puh	plain-slope, floodplain/escarpment, sand-crest/sand-plain	Silurian sandstone, Quaternary alluvium, Quaternary colluvium	yellow duplex, uniform sand	640-700	10-200
ylap, PLH, nlh, puh	plain-slope	Silurian mudstone, Silurian sandstone, Quaternary colluvial	yellow duplex	660-700	30-180
ylap, puap, plh, plvp, YLH, nlh, PUH	exposed stream valley, plain-slope	Silurian mudstone, Silurian sandstone, Devonian siltstone	yellow duplex	660-700	30-220
ylh, PUH	foothill alluvial flat	Silurian sandstone, Quaternary alluvium	yellow duplex	680-740	180-220
mlvp	buckshot crest	Quaternary volcanics	red duplex	600-620	140-160
ylap, PLH ylh	sand-plain	Tertiary river alluvium	yellow-red duplex	640-700	90-200
plh	sand-plain	Tertiary river alluvium	yellow-red duplex	640	90-100
YLAP	billabong	Quaternary alluvium	black uniform clay	660-680	8-15
YLAP	riverbank	Quaternary alluvium	yellow duplex, uniform sandy loam	660-680	5-12
plvp, YLAP	stream terrace	High level alluvium	yellow duplex	660-680	10-15

Appendix 1.1 Habitat Types of NEM

Vegetation community	Sub-community		Character species	Conservation status		
	No.	Dom. canopy		VIC	GM	NEM
	16.4	Manna Gum	Common Tussock-grass, Silver Wattle, Woolly Tea-tree	Cat 1	Depleted	Occurrence: restricted; Threats: high; Reservation: adequate
	16.5	Manna Gum	Common Tussock-grass, Black Wattle, Kangaroo Apple	Cat 1	Depleted	Occurrence: restricted; Threats: high; Reservation: adequate
	16.6	River Red Gum	Common Tussock-grass, Silver Wattle, Woolly Tea-tree	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
Swamp Scrub	17.1	Swamp Paperbark	Swamp Gum, Tree Everlasting, Prickly Moses	Cat 2	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
Riparian Scrub	18.1	Muttonwood	Silver Wattle, River Bottlebrush, Manna Gum	Cat 1	Disjunct	Occurrence: localised; Threats: moderate; Reservation: adequate
	18.2	Woolly Tea-tree	Silver Wattle, Hemp Bush, River Red Gum	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Upland Scrub	19.1	Broad-leaved Peppermint	Prickly Broom-heath, Trail/g Ground-berry, Gorse Bitter-pea	Cat 3	Disjunct	Occurrence: localised; Threats: low; Reservation: adequate
Cliff/Escarpment Shrubland	20.1	Blanket-leaf, Musk Daisy-bush, Blackwood	Common Maiden-hair, Grey Tussock-grass, Clustered Everlasting	Cat 4	Disjunct	Occurrence: localised; Threats: low; Reservation: adequate
	20.2	Burgan, Sweet Bursaria	Common Maiden-hair, Dogwood, Clustered Everlasting	Cat 4	Disjunct	Occurrence: localised; Threats: high; Reservation: adequate
	20.3	Gorse Bitter-pea, Varnish Wattle, Dusty Miller	Black-anther Flax-lily, Hoary Sunray, Small-leaf Parrot-pea	Cat 4	Disjunct	Occurrence: localised; Threats: medium; Reservation: adequate
	20.4	Golden Wattle, Black Wattle	Saloop Saltbush, Sticky Boobiolla, Wedge-leaf Hop-bush	Cat 4	Disjunct	Occurrence: localised; Threats: high; Reservation: adequate
	20.5	Lightwood, Tree Violet	Kangaroo Grass, Drooping Sheoke, Tree Bursaria	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Damp Heath	21.1	Swamp Bush-pea, Heath Tea-tree, Common Heath	Thatch Saw-sedge, Wiry Spear-grass, Scrub Sheoke	Cat 4	Disjunct	Occurrence: localised; Threats: moderate; Reservation: inadequate
Stony Knoll Grassland	22.1	Kangaroo Grass	Short Wallaby-grass, Hedge Wattle, Tree Violet	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Plains Grassland	23.1	Common Tussock-grass	Common Sedge, Brown-back W/-grass, Kangaroo Grass	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
	23.2	Kangaroo Grass	Velvet Tussock-grass, wallaby-grasses, Grassy Bindweed	Cat 1	Threat'd	Occurrence: widespread; Threats: high; Reservation: inadequate
Drainage Line Herbfield	24.1	Common Spike-sedge	Fine Twig-sedge, Salt Pratia, Shiny Swamp-mat	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
Seasonal Wetland	25.1	Rush Sedge, Common Spike-sedge, Austral Rush	Common Tussock-grass, River Sw W/-grass, White Purslane	Cat 1	Disjunct	Occurrence: localised; Threats: moderate; Reservation: adequate
	25.2	Common Tussock-grass, Rush Sedge	Common Spike-sedge, Common Blown Grass, Veined Sw W/-grass	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
	25.3	Brown-back Wallaby-grass	Small Spike-sedge, Milky Beauty-heads, Poison Lobelia	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
(floodplain herbfield)	25.4	Tall Sedge, Soft Bog-sedge	Common Spike-sedge, Common Love-grass, Swamp Isotome	Cat 1	Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
(floodplain herbfield)	25.5	Sword Tussock-grass, Tall Sedge	Common Tussock-grass, Tassel Sedge, Australian Sw/t-grass	Cat 1	Depleted	Occurrence: restricted; Threats: moderate; Reservation: inadequate
	25.6	Creeping Knotweed, Matted Water Starwort	Common Blown Grass, River Sw W/-grass, Spreading Sneezeweed	Cat 1	Disjunct	Occurrence: localised; Threats: high; Reservation: adequate
(emergent herbfield)	25.7	Common Reed, Cumbungi, Tall Spike-sedge	Common Spike-sedge, Floating Pondweed, Swamp Crassula	Cat 1	Secure	Occurrence: localised; Threats: low; Reservation: adequate
	25.8	Common Blown Grass	Brown-back Wallaby-grass, Annual Celery, Plains Buttercup	Cat 1	Threat'd, Disjunct	Occurrence: localised; Threats: high; Reservation: inadequate
Permanent Wetland (submerged/ floating herbfield)	26.1	Blunt Pondweed, Pacific Azolla	Lake Eel-grass, Common Duckweed, Yellow Bladderwort	Cat 1	Secure	Occurrence: restricted; Threats: low; Reservation: adequate
Swampy Woodland	27.1	Swamp Gum	Austral Bracken, Burgan, Prickly Tea-tree	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Swampy Riparian Woodland	28.1	Swamp Gum	Black Wattle, Blackwood, Swamp Paperbark	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Granite Hills Woodland	29.1	Drooping Sheoke, Black Wattle	Kangaroo Grass, Hedge Wattle, Tree Violet	Cat 1	Threat'd	Occurrence: localised; Threats: high; Reservation: inadequate
Drainage Line woodland	30.1	River Red Gum	Rush Sedge, Common Spike-sedge, Slender Knotweed	Cat 1	Threat'd	Occurrence: restricted; Threats: high; Reservation: inadequate
Valley Forest	31.1	Yellow Box, Candlebark	Common Tussock-grass, Common Cassinia, Burgan	Cat 1	Depleted	Occurrence: widespread, Threats: medium, reservation: inadequate

Appendix 1.1 Habitat Types of NEM

				Rainfall	Elev'n
Biophysical zone	Landform	Geology	Soil	(mm)	(m)
plvp, ylap, puap, PLH, ylh	riverbank (Silurian)	Quaternary alluvium	yellow gradational, grey uniform clay, uniform sandy loa	640-780	15-220
plvp, ylap, PLH	stream terrace (Silurian), floodplain	high level alluvium	yellow duplex, yellow gradational	640-680	20-160
muvp, plvp, ylap	creek (Silurian)	Quaternary alluvium	grey uniform clay	640-680	10-260
YLAP, PUAP, YLH	billabong/backswamp, river floodplain	Quaternary alluvium	black uniform clay	660-780	10-200
ylap, PLH, YLH	sedimentary river rapid	Quaternary alluvium	yellow gradational, uniform sandy loam	640-780	10-150
MUVP, MLVP, plvp	volcanic stream	Quaternary alluvium	black uniform clay	600-660	20-240
KR	exposed mountain spur	Silurian sandstone, Devonian siltstone	yellow gradational	700-750	450-500
KR	sheltered waterfall cliff	Devonian mudstone	stony gradational	750-850	250-350
ylap, PLH, YLH	sheltered river escarpment, sheltered river cliff	Silurian sandstone	stony gradational	640-760	30-150
KR	exposed waterfall cliff	Devonian mudstone	stony gradational	750-850	250-350
YLAP, PLH, YLH	exposed river escarpment, exposed river cliff	Silurian sandstone	stony gradational	640-760	10-150
MUVP, MLVP, PLVP, ylap, PLH	volcanic stream escarpment, volcanic stream cliff, volcanic cone	Quaternary volcanics	red gradational, black uniform clay	600-660	20-260
KR	foothill valley soak	Devonian siltstone	red duplex	720-740	240
MUVP, MLVP, PLVP	stony rise/crest	Quaternary volcanics	red gradational, brown uniform	600-660	100-320
MUVP, MLVP, plvp	plain-slope/cone-slope, gilgai plain/creek terrace, stony knoll apron swa	Quaternary volcanics	grey-black duplex, grey uniform clay, black uniform clay	600-660	120-320
MUVP, MLVP, PLVP	stony plain, gilgai plain, silt plain	Quaternary volcanics	grey-black duplex, brown duplex, black uniform clay	600-660	120-350
muvp, MLVP, plvp	volcanic drainage line	Quaternary alluvium	Grey uniform clay	600-650	140-260
plvp, YLAP, PUAP, PLH, PUH	swamp (alluvial plain), freshwater meadow, shallow freshwater marsh	Quaternary alluvium	black uniform clay	650-700	20-220
MUVP, MLVP, plvp	swamp (volcanic plain), freshwater meadow, shallow freshwater marsh	Quaternary alluvium	black uniform clay	600-650	100-320
MUVP, MLVP, PLVP, plh	ephemeral swamp (volcanic), gilgai/swale	Quaternary alluvium	black uniform clay	600-650	80-320
ylap, PLH	floodplain swamp	Quaternary alluvium	black uniform clay	640-680	20-110
muvp, PUAP, plh, nlh, YLH, HR	floodplain swamp	Quaternary alluvium	black uniform clay, brown gradational	680-800	60-250
YLAP	billabong mudflat	Quaternary alluvium	black uniform clay	660-680	10-20
ALL	shallow freshwater marsh, deep freshwater marsh, artificial impoundme	Quaternary alluvium	black uniform clay	600-900	10-300
MLVP	dry lake	Quaternary alluvium	grey uniform clay	600	180
ALL	shallow freshwater marsh, deep freshwater marsh, artificial impoundment			600-900	10-300
muvp, puap, puh, ylh	stream floodplain	Quaternary volcanics, Quaternary alluvium	black uniform clay, grey uniform clay	660-800	60-300
muvp, puap, puh, ylap, ylh	creek	Quaternary alluvium	yellow gradational	600-800	15-280
PLVP	granitic tor	Devonian granodiorite	yellow duplex sand	640-660	180-270
muvp, mlvp, PLVP, YLAP, puap, plh	creek/drainage line	Silurian sandstone, Quaternary volcanics, Quaternary alluvium	yellow duplex, grey uniform clay	600-700	20-250
puap, plh, YLH, NLH, NUH, puh, hr	sheltered foothill valley	Silurian mudstone, Silurian sandstone, Devonian siltstone	yellow duplex	640-750	30-320

THE HABITATS OF NORTH EAST MELBOURNE

The following is a brief discussion of the derivation of the vegetation communities listed in Appendix 1.1. Variance from EVC nomenclature is noted. Readers are advised to refer to Beardsell (in prep.) for detailed discussions on 13 of the following communities (31 sub-communities) which occur in Plenty Gorge Park. These include 6.1/2, 10.1/3, 11.1-3, 12.2/3, 13.1-3, 14.1-3/5, 15.1/2, 16.4/5, 18.1/2, 20.2/4/5, 25.1/3/4/7, 26.1 and 30.1.

- 1 **cool temperate rainforest:** localised above 550 m elevation and 1200 mm rainfall along sheltered mountain tributaries of Plenty River East Branch. High frequency of regionally threatened and disjunct plants including Myrtle Beech, Slender Tree-fern and fern epiphytes.
- 2 **wet forest:** high rainfall sections above 350 m in the ranges. Mountain Ash canopy 40–80 m tall and 20–40% cover (lower level in old-growth forest in Plenty River headwaters and upper level in regrowth forest elsewhere). Dense stratum of tall mesophyll shrubs.
- 3 **damp riparian forest:** separated on topographic/faunal habitat basis from EVC–damp sclerophyll forest and wet forest. Middle altitude mountain streams.
- 4 **damp sclerophyll forest:** includes EVC–shrubby foothill forest. This occupies mountain spurs and in this study is referred to as Mountain Grey Gum damp sclerophyll forest (4.1). With decreasing rainfall and elevation, damp sclerophyll forest is replaced by herb-rich foothill forest. With increasing rainfall and elevation the community is replaced by wet sclerophyll forest. Damp sclerophyll forest differs from wet forest by occupying more exposed (fire-prone) sites containing an abundance of fire-stimulated sclerophyll shrubs (particularly peas), herbs and grasses and a lower diversity and abundance of ferns, apart from fire-stimulated species such as Austral Bracken and Common Ground-fern.
- 5 **riparian forest:** Manna Gum alliances along perennial streams in the foothills. Replaced by floodplain riparian woodland on the plains and gully woodland along semi-permanent streams in the foothills. Habitats occurring along banks (5.1 and 5.3) are differentiated from that on terraces (5.2).
- 6 **herb-rich foothill forest:** formerly referred to as dry sclerophyll forest. This community occurs on sheltered slopes and stream escarpments in the foothills and lower rainfall sections of the ranges. 6.1 and 6.2 occupy drier sections of the foothills and support several character lowland species including Yellow Box, Red Box and Candlebark and sclerophyll (narrow-leaved) shrubs in common with box–stringybark woodland and grassy woodland. 6.3 occupies the damper foothills and ranges and mesophyll (broad-leaved) shrubs become prominent. With increasing rainfall and elevation, 6.3 grades into damp sclerophyll forest. Soil development and moisture promote a moderate cover of shrubs (particularly wattles and peas), sedges and ferns.
- 7 **riverine forest:** reduced by land-clearing to one stand on grazing land at Yan Yean. Despite shrub layers being absent, it is included as a reference stand, largely from biogeographic and avifaunal significance. The stand is a remnant of a marshland system of riverine forest, swamp scrub and seasonal and permanent wetland. The marshlands occupied 1850 ha from Yan Yean to Whittlesea and east to include the area now inundated by Yan Yean Reservoir (known as Ryder Swamp). Along with the Yering–Yarra Glen Flats of the Middle Yarra, the area formed the most extensive marshland in NEM.

Riverine forest occupied the well-watered and fertile upper floodplain of the Plenty River. Prior to diversion of water from the Plenty River into the Toorourrong–Yan Yean Reservoir system (1857), an extensive area of flood-water backed up at the head of the Plenty Gorge. Due to bluffs west of Plenty Road and to the east (now Yan Yean Reservoir), water lay for several months of the year. The forest density exceeded 100 trees/ha and was composed of tall non-spreading trees with boles of up to 15 m before branching (see p. 76 in Wuchatsch and Hawke, 1988). The community has structural, floristic and biogeographic similarity (particularly fauna) with floodplain vegetation of the middle Murray River (e.g. Barmah Forest).
- 8 **heathy forest:** equivalent to EVC–heathy dry forest. Occurs on exposed mountain spurs (e.g. Mt Beggary in Kinglake NP). Grades upslope into Mountain Grey Gum damp sclerophyll forest (4.1) on the plateau (e.g. upper Bald Spur).
- 9 **heathy woodland:** this is composed of two upland habitats. Mealy Stringybark (9.1) consists of ‘dry tea-tree heath’ on well-drained hill-slopes. It associates upslope with heathy forest (8.1). Messmate–Mealy Stringybark (9.2) consists of ‘damp tea-tree heath’ on seasonally waterlogged clay-peat soils in valleys and minor gullies. At Broad Gully in Kinglake NP, 9.2 associates downslope with gully woodland (10.2) and grades into damp heath (21.1) in valley soaks. Heathy woodland typically occupies sand-sheets in southern Victoria and probably consists of several ‘treed heath’ vegetation communities. These include heathy valley forest and swampy gully forest, both of which have affinity with 9.2. Other character species elsewhere include Brown Stringybark and Shining Peppermint.
- 10 **gully woodland:** segregated from EVC–valley forest. It forms a woodland canopy (trees fewer than 100/ha) and occurs along non-permanent watercourses. There is a consistent riparian component (e.g. Slender Knotweed). The community is a bridge between River Red Gum drainage line woodland (30.1) of the plains and damp sclerophyll forest of the mountains. This is largely determined by intermediate environmental factors such as rainfall and slope.

- 11 box-stringybark woodland:** equivalent to EVC–grassy dry forest. The name is standardised to nomenclature used by Ecology Australia in local studies within North East Melbourne. The community occurs in exposed, open foothill environments (hill-crests, exposed hill-slopes and spurs) and has a grass-dominant stratum indicative of dry mountain areas (e.g. Silvertop Wallaby-grass). This is most evident in 11.4 of exposed spurs along the foothills of the ranges. The community also supports grasses and shrubs indicative of the plains (e.g. Kangaroo Grass, Wiry Buttons and Golden Wattle). This is most evident in 11.2 of exposed river spurs and hill-crests of the Silurian sandstone formations. Also 11.3, which is restricted to exposed valleys of the Silurian mudstone/siltstone formations in the lowland hills. 11.3 also supports components of herb-rich foothill forest (e.g. Spiny-headed Mat-rush and Thatch Saw-sedge). Box–stringybark woodland is the ecological bridge dividing lowland grassy woodland from herb-rich foothill forest and heathy forest of the uplands. It supports a characteristic and diverse orchid assemblage (e.g. spider-orchids).
- 12 box-ironbark woodland:** includes all alliances dominated by Red Ironbark and/or Yellow Gum. Those containing Yellow Gum (12.2/12.3) on spurs of Plenty River have strong floristic affinity with vegetation of the Brisbane Ranges and north-central Victorian goldfields. The prominence of chenopod shrubs also has floristic affinity with cliff/escarpment shrubland, which occurs on adjacent cliffs in the Plenty Gorge. The cover and diversity of low shrub and herb layers in the Plenty Gorge has been reduced substantially by severe grazing pressure from kangaroos and rabbits. 12.1 occurs in higher rainfall/elevation areas and is the western end of the range of Gippsland Red Ironbark forests. The dominance of Thatch Saw-sedge and occurrence of ‘heathland’ orchids, Blue Dampiera and Messmate in a saddle seepage area of 12.1 at Boomers Reserve provides affinity with heathy woodland (9.2).
- 13 escarpment woodland:** three habitats with heterogenous floristic and structural composition due to proximity of other vegetation types on a topographic gradient supporting dynamic physical processes (e.g. soil, moisture etc.). These have floristic affinities with several other communities (e.g. 13.2 and 13.3 with box–stringybark woodland and 13.1 with valley forest). Escarpment woodland also has affinity with grassy woodland. Character species in common include Kangaroo Grass, Common Tussock-grass, Spur Velleia, Yellow Box, Broad-leaf Stinkweed and Curved Rice-flower. The habitats have a narrow occurrence along lowland rivers and share characteristic flora and fauna species of the river environment, particularly with cliff/escarpment shrubland.
- 14. grassy woodland:** with the exception of 14.6 and 14.8, equivalent to EVC–plains grassy woodland. Usage of the word plains has been dropped in this study as several of the constituent habitats largely occur in the foothills. The name grassy woodland has been standardised with nomenclature used by Ecology Australia in other regional studies within North East Melbourne. This application is derived from the Land Conservation Council Melbourne Area District 2 Review (LCC 1991). Yellow Box–Candlebark (14.6) is segregated from the EVC–valley forest. It forms a woodland canopy (trees of less than 100/ha) and contains a grassy understorey with dominants including Kangaroo Grass, Hedge Wattle and a suite of other flora and fauna (e.g. parrot) species in common with the plains.

14.6 has been virtually eliminated from valleys of the alluvial plains where it occurred above 14.3 or 14.5 on plain-slopes or swampy woodland (27.1) on floodplains. It is restricted in the lowland hills to the exposed sides of broad stream valleys where usually bordering riparian forest (5.1–5.3), or occasionally gully woodland (10.1/10.3). 14.6 also extends onto plain-slopes in low rainfall sections of the upland hills (e.g. Yan Yean Reservoir). In narrower and more sheltered foothill valleys, 14.6 is replaced by valley forest (31.1). 14.6 has closest floristic similarity to Blakely’s Red Gum grassy woodland (14.5). 14.6 is essentially a bridge between River Red Gum (plains) grassy woodland (14.1/14.3) and box–stringybark woodland (11.2/11.3) at the dry continuum and herb-rich foothill forest (6.1/6.2) at the damp continuum.

Snow Gum grassy woodland (14.7) at Yan Yean Reservoir has substantial biogeographic significance. Related sub-communities occur in montane rainshadow areas of the Eastern Highlands and tablelands of the Western Highlands. 14.7 is a remnant of the last glaciation (15–18 000 years ago) in which a cold and dry climate with intense frosts moved the snowline and Snow Gums down to the lowland plains. ‘High’ country over about 500 m was converted to treeless ice sheets or grass plains and climate of the Melbourne area was sub-alpine. 14.7 became a stranded ‘ark’ in the post-glacial warming millennia that followed.

Yellow Box–Hill Manna Gum grassy woodland (14.2) of volcanic cappings and cones occurs in a disjunct distribution from Beveridge to Kangaroo Ground. East of the Plenty River, it occurs on Tertiary formations and west of the river, it occurs on Quaternary formations. The small extension of Grey Box into the study area at Campbellfield is grouped under grassy woodland (14.8). Further west in low rainfall areas between Melton and Bacchus Marsh it is associated with Buloke and referred to as EVC–box woodland.

- 15 sand-plain woodland:** restricted to the Tertiary sand-plain (e.g. Janefield in the Plenty Gorge). The prominence of tall shrubs provides structural affinity to grassy low open-forest (characterised by Coast Manna Gum) which occurs on marine sands on the east side of Port Phillip Bay and southern Mornington Peninsula. They occupy differing landform, floristic and environmental parameters. The two communities probably graded into each other in the south-eastern suburbs of Melbourne. On sheltered sites, stands are ecotonal (at an ecological transition) with herb-rich foothill forest, as they contain taller (15 m) and more closely spaced trees. The community also grades downslope into gully woodland and into escarpment woodland along streams (e.g. Janefield in the Plenty Gorge).

- 16 floodplain riparian woodland:** alluvial plain stream alliances dominated by River Red Gum in the Lower Yarra and Manna Gum in the Middle Yarra and Plenty River. Replaced by riparian forest in the foothills and riparian scrub on the volcanic plains. As for riparian forest, habitats occurring along banks (16.2 and 16.4) are differentiated from those on terraces (16.3 and 16.5). Another unique to billabongs of the Lower Yarra (16.1) is also identified.
- 17 swamp scrub:** characterised by Swamp Paperbark on the lower floodplain of Plenty River between Yan Yean and Whittlesea and Yarra River billabongs at Yering Flats and between Kew and Bulleen. 17.1 is usually associated with seasonal wetland (25.5 and 25.7) and permanent wetland (26.1). These are included under EVC–swamp scrub but are treated separately in this study.
- 18 riparian scrub:** riparian communities represent vegetation of streams and floodplains. Riparian scrub is characterised by a band of shrubs and dense growth of reeds, rushes and sedges. The community is richer than riparian forest and floodplain riparian woodland. 18.2 (Woolly Tea-tree) occurs on the volcanic plains (e.g. Frood 1992). River Red Gums are presumed to be much less frequent in 18.2 than at the time of European settlement. This study also recognises an alliance characterised by Muttonwood (18.1) at rapids in sedimentary river gorges (Yarra and Plenty).
- 19 upland scrub:** included under EVC–heathy dry forest. Localised occurrences in rainshadow areas at Bald Spur and Mt Everard in Kinglake NP. Dense canopy stratum (Broad-leaved Peppermint) of 2–8 m tall with a moderately dense low shrub stratum. The community is a structural variant of heathy forest *.1), in response to the rigorous environmental conditions of razorback spurs. On floristics it would be classified under heathy forest.
- 20 cliff/escarpment shrubland:** previously recognised in the Middle Yarra by Rosengren, Frood and Lowe (1983) but otherwise included within neighbouring vegetation classes due to its localised occurrence. Included under box–stringybark woodland or chenopod rocky open scrub by authors in areas west of Melbourne. 20.2 and 20.4 are restricted to sedimentary formations in lowland river gorges (Yarra and Plenty) while 20.1 and 20.3 have localised occurrences at waterfalls in the ranges (e.g. Masons Falls). 20.5 occurs along volcanic streams (e.g. Merri Creek). West of the Hume Freeway (where rainfall is below 600 mm), and on some low rainfall volcanic cones containing columnar basalt outcroppings in NEM (e.g. Mount Cooper at Bundoora), the vegetation is analogous to 20.5. The latter has been virtually eliminated. Cliff-escarpment shrubland contains a higher proportion of scrambling herbs and ferns than adjoining habitats. Many of these species have disjunct distribution. Disturbed stands are vulnerable to weed invasion.
- 21 damp heath:** equivalent to EVC–clay heathland. Diverse alliance of regionally threatened and disjunct plants on clay-peat, valley soaks at Broad Gully in Kinglake NP. Disjunct community in GM (e.g. Mt Evelyn and Brisbane Ranges). Distinct from EVC–wet swamp heath of coastal sand-sheets which is dominated by paperbarks.
- 22 stony knoll grassland:** sub-community complex with native grassland of varying quality. Differs from plains grassland with the presence of extensive surface rocks and drier, friable brown or red loams. The rocks offer some protection for sensitive herbs from grazing livestock. As a result, the community generally supports higher richness of native species than plains grassland. At the time of settlement, shrubs in common with cliff/escarpment shrubland (20.5) would have been more prominent and the community would be more correctly termed stony knoll shrubland.
- 23 plains grassland:** diverse, usually treeless sub-community complex lumped into alliances dominated by Common Tussock-grass (23.1) in seasonally damp to wet areas and Kangaroo Grass (23.2) in situations ranging from seasonally damp to dry. Soils are usually cracking grey or black clays with medium to high development of gilgai topography and low to medium development of surface rocks. The community consists of native grassland of varying quality according to management history. Ungrazed sections usually have a closed structure, supporting lower species richness. Some lightly grazed sections (e.g. Craigieburn Grassland) support higher species richness, the cover of tussocks affording shelter for grazing sensitive species. Heavily grazed sections revert to open grazing land dominated by wallaby-grasses. Areas that have been cultivated or low-lying sections disturbed from periods of intense livestock grazing tend to be degraded and weed invaded. The community shares ecotones with several other plains communities (see habitat description in introductory section of Volume 2).
- 24 drainage line herbfield:** equivalent to grey clay drainage line complex described for Summer Hill drainage line at Craigieburn Grassland by Frood (1992). Brackish meadow at a dry lake in the north section has been included as seasonal wetland (25.8) in this study. The vegetation of Summer Hill drainage line is distinctly zoned into sedgeland fringing aquatics at ponds, herbland in rocky sections and grassland on terraces. The latter is included under plains grassland (23.1) and supports an extensive population of the endangered Tough Scurf-pea. Several species including Australian Salt-grass, Shiny Swamp-mat and Creeping Monkey-flower of 24.1 are shared with brackish saltmarshes. The most extensive population in Victoria of the vulnerable Curly Sedge occurs along the drainage line.

- 25 seasonal wetland:** equivalent to EVC–swamp wetland. Seasonal wetland is composed of semi-aquatic (usually zonal) herbfields often lumped by previous authors under ‘wetland complex’. Eight habitats are recognised for NEM, though numerous other floristic combinations exist. As well as on character species composition, these are categorised on landform type and inundation regime (e.g. shallow freshwater marsh, freshwater meadow etc.). 25.2 is equivalent to EVC–plains grassy wetland. 25.1 and 25.7 mainly occur at artificial waterbodies and provide habitat of particular importance to frogs and shorebirds. Most natural marshland occurrences of these habitats have been eliminated by clearing and draining. 25.7 naturally occurs in association with swamp scrub and permanent wetland at billabongs of the Yarra. 25.3 of volcanic gilgais and stony knoll apron swales has been previously incorporated under plains grassland (e.g. Frood 1992). It has been included as a seasonal wetland habitat in this study. Similarly, billabong mudflat (25.6) of the Lower Yarra and brackish meadow (25.8) at a dry lake in the north of Craigieburn Grassland, have also been identified. Many seasonal wetland plants occur in association with emergent herbfield fringing streams. These are included under riparian forest (5), floodplain riparian woodland 9160, riparian scrub (18), drainage line herbfield (24) or drainage line woodland (30).
- 26 permanent wetland:** aquatic herbfield that is free-floating or submerged and attached to the substrate of permanent waterbodies. Most occurrences are at artificial impoundments (e.g. reservoirs and quarries). The main natural occurrence remaining in NEM is at billabongs along the Yarra floodplain. The community provides habitat of importance to waterfowl and fish. **Note:** The following are additional communities included after discussions with Doug Frood. In structural order, 27 and 28 should follow community 16, 29 and 30 should follow 15, while 31 should follow 6.
- 27. swampy woodland:** characterised by Swamp Gum and formerly Yarra Gum on the floodplain of Plenty River/tributaries above Whittlesea, Yarra River at Yering Flats and Merri Creek at Beveridge. On the upper floodplain of the Middle Yarra, 27.1 flanks 5.2 (floodplain terrace/riparian forest), 16.4 (riverbank/floodplain riparian woodland), 17.1 (swamp scrub) or 25.5 (seasonal wetland) on the lower floodplain and 28.1 (swampy riparian woodland) along creeks (Brushy and Olinda creeks). The most intact stand of 27.1 remaining in NEM occurs on the river meander south of Yering Backswamp. The most cleared and degraded habitat in NEM.
- 28. swampy riparian woodland:** characterised by Swamp Gum, Yarra Gum, Black Wattle, Blackwood, Swamp Paperbark, Tall Sedge and Sword Tussock-grass along Plenty River and its tributaries upstream of Whittlesea. Also occurring along streams entering Yarra River adjoining the study area (e.g. Olinda Creek, Brushy Creek and Koonung Creek). Associated with creeks flowing through floodplain marshland where usually bordered by swampy woodland (27.1), seasonal wetland (25.5) and swamp scrub (17.1) at billabongs.
- 29 granite hills woodland:** characterised by Drooping Sheoke on localised granite outcrops (Quarry Hill) of the volcanic plains. Elsewhere in GM at Gellibrand Hill and the You Yangs.
- 30. drainage line woodland:** the widespread River Red Gum alliance along non-permanent drainage lines of the plains (30.1) is distinguished from grassy woodland (14) by the semi-aquatic herbfield (e.g. Water Plantain, Rush Sedge, Common Spike-sedge, Swamp Club-sedge, rushes, Water-ribbons, Australian Sweet-grass, pondweeds, Cumbungi, Lesser Joyweed, Slender Knotweed etc). The ecological/topographic relationship of 30 and 14 on the plains is similar to that between gully woodland (10) and valley forest (31) in the foothills. This is also consistent with the separation of swampy riparian woodland (28.1) from swampy woodland (27.1) on stream floodplains. Alliances of 30.1 on the volcanic plains and alluvial plains could well be distinct at the sub-community level (e.g. absence of Swamp Paperbark from the former).
- 31. valley forest:** this EVC replaces Yellow Box–Candlebark grassy woodland (14.6) in steeper or more sheltered foothill valleys. Character mountain species of 31.1 not occurring in 14.6 include Narrow-leaf Peppermint, Messmate, Snow Daisy-bush and Prickly Currant-bush. Other differences include Common Tussock-grass dominating over Kangaroo Grass and Common Cassinia, Hill Silver Wattle, Burgan and Cluster Pomaderris replacing Dogwood, Hedge Wattle and Golden Wattle. Thatch Saw-sedge dominates seepages. 31.1 usually fringes gully woodland (10.1-3) along minor creeks and drainage lines. With increasing elevation, rainfall and soil moisture in the upland hills, 31.1 grades into herb-rich foothill forest (6.1/6.3).

Please note. EVC–valley forest consists of a broad range of habitats which are difficult to define on the basis of landform. Several of these are placed in other communities including gully woodland (10.1–10.3), box–stringybark woodland (11.3 and grassy woodland (14.6). Valley forest is characteristic of north-eastern Victoria and extends from the Goulburn River valley into the Melbourne Area through the Kilmore Gap.

APPENDIX 1.2 SUMMARY OF FAUNAL SIGNIFICANCE CRITERIA, SUB-CRITERIA AND CATEGORIES

Faunal Significance Rating			Criteria , Sub-criteria and Categories
National	State	Regional	Significance rating
>4 sub-criteria	>7 sub-criteria	>9 sub-criteria or criteria 2–6	Category 1
3-4 sub-criteria	4-7 sub-criteria	6-9 sub-criteria	Category 2
1-2 sub-criteria	1-3 sub-criteria	1-5 sub-criteria	Category 3
			A. Cited Zoological Significance
national	state	regional	1.The zoological significance cited within the study period by an accredited authority/study.
			B. RARITY: Rare or threatened fauna
			A 1' grid supports:
			a. Endangered fauna
x			A species or subspecies listed (or proposed for listing) as endangered in Australia.
	x		Single sighting in natural habitat of a migratory/nomadic bird or fish species listed as endangered in Australia or Victoria
			b Vulnerable fauna
x			Two species or sub-species listed (or proposed for listing) as vulnerable in Australia. *
	x		A species or subspecies listed (or proposed for listing) as vulnerable in Australia or Victoria
		x	Sighting of a migratory/nomadic bird or fish species or sub-species listed as vulnerable in Australia or Victoria
			c. Rare fauna
			C. DIVERSITY: Species/assemblage richness—point census/trapping
			Count census or trapping diversity.A 1' or 2' grid supports:
10-14	4-9	2-3	a. International migratory waders..
>39	30-39	20-29	b. Waterbirds
>14	7-14	4-6	c. Breeding Seabirds
>10	7-10	4-6	d. Breeding waterfowl
>12	9-12	5-8	e. Honeyeaters
	>12	7-11	f. Breeding migratory insectivores.
	>7	5-7	g. Breeding parrots.
	>7	4-7	h. Bats.
	>6	4-6	i. Arboreal mammals.

Faunal Significance Rating		
National	State	Regional
	>8	5-8
	>9	6-9
	>10	6-10
	>4	2-4
		x
>200	>9	140-200
>150	110-149	70-140
	>22	>4
	>25	7-21
	>6	9-24
	>29	3-5
		15-29
>8	4-7	1-3
>49	25-49	15-24
		x
		x
		x
		x
		x
		x
		x
		x
		x

Criteria , Sub-criteria and Categories

Significance rating

j. Ground mammals.

k. Frogs

l. Reptiles

m. Freshwater Fish

n. Other fauna. Regionally significant assemblages of other faunal groups.

D. REPRESENTATIVENESS: Faunal assemblages—reference grid survey

General grid survey. A 1' or 2' grid supports:

a. All native fauna. (i.e. terrestrial vertebrate fauna.)

The most diverse faunal assemblage known within a biophysical type

b. Native birds

c. Native mammals

d. Herpetofauna

e. Freshwater fish

f. Butterflies

E. REPRESENTATIVENESS: Significant species—reference grid survey

General Grid survey. A 1' grid supports:

a. Victorian rare fauna

species or subspecies listed as rare, potentially threatened, insufficiently known or indeterminate in Australia or Victoria

b. Critical fauna

Critical species that are regionally threatened, rare or restricted.

c. Regionally vulnerable fauna

A native terrestrial vertebrate species or subspecies recorded from 1-20 (< 2.5%) surveyed 2' grids in GM.

For freshwater fish, 1-5 (<10%) of the electrofish sites in NEM.

d. Regionally rare fauna.

Four or more native terrestrial vertebrate species recorded from 21-40 of the surveyed 2' grids in NEM.

Breeding populations of one or more of the above species.

For freshwater fish, 6-10 of the electrofishing sites in NEM.

e. Regionally restricted fauna

Ten or more native terrestrial vertebrate species recorded from 41-80 of the surveyed 2' grids in GM.

Breeding populations of four or more of such species recorded from 41-80 of the surveyed 2' grids in NEM

For freshwater fish, 10-20 of the electrofishing sites in NEM.

Faunal Significance Rating

Criteria , Sub-criteria and Categories

National	State	Regional	Significance rating
		x	f. Nesting birds of prey/parrots. One or more of the Swamp Harrier, Spotted Harrier, Wedge-tailed Eagle, Black Kite, Whistling Kite, Australian Hobby, Peregrine Falcon, Black Falcon, Collared Sparrowhawk, Barking Owl, Powerful Owl, Sooty Owl or Masked Owl; or of the Yellow-tailed Black Cockatoo, Gang-gang Cockatoo, Purple-crowned Lorikeet, Little Lorikeet, Little Corella, Long-billed Corella, Cockatiel, Australian King Parrot, Blue-winged Parrot or Budgerigar.
			F. POPULATION DENSITY: Viability and abundance Count, census or trapping density. A 1' grid supports:
			a. International migratory birds
1000 -3000	100-1000	10-100	Waders, excluding Latham's Snipe.
10,000-20,000			Waders occupying a larger contiguous area. (Adapted from Lane et. al. 1984).
>250	50-250	5-50	Latham's Snipe.
5000-10 000	500-5000	100-500	other migratory birds covered under international treaties e.g. JAMBA or CHAMBA (Schulz <i>et al.</i> 1991).
			b. Rare or threatened fauna
100-500			individuals of a species or subspecies listed as vulnerable in Australia. *
	>50	5-50	individuals of a species or sub-species listed as rare, potentially threatened, insufficiently known or indeterminate in Australia or Victoria.
Victoria	GM		>1% and <5% of the known population of the above species or sub-species in ____, or for non-gregarious fauna, one of the highest population densities.
	x		For non-gregarious fauna, one of the highest population densities
5000-10 000	500-5000	200-500	c. Waterfowl.
>5000	500-5000	100-500	d. Breeding seabirds
>1,000	200-1000	50-200	e. Honeyeaters
			f. Frogs. At a single wetland or wetland complex.
>5	4-5	2-3	>30 of each of relevant number of species. **
>300			of each of three or more species. **
>3000 2	300-3000 2	>300 1	relevant number of any species at a single wetland or wetland complex. **
			g. Rare/restricted colonial fauna.
>2000	100-2000	10-100	in a breeding or roosting colony of rare or insufficiently known cave dwelling bats or restricted colonial birds. ***
	>1000	50-1000	A breeding or roosting colony or a feeding aggregation of any other colonial species. ****
			h. Other fauna.
>10%	5-10%	5-10%	____ of the known Victorian population of any non-threatened species or subspecies (Schulz <i>et al.</i> 1991).
		x	More than 1,000 individuals (or >1% of the total known NEM population, or highest known population density) of any native species not included above.
			____ > 1,000 individuals (or >1% of the total known NEM population, or highest known population density) of any native species not included above.
			i. Bat trapping rate.
	>60	30-59	A single trap capture of bats of more than four species.

	>30	10-29
Faunal Significance Rating		
National	State	Regional
	>500	30-500
		x
		x

A trap-night average of bats of at least four species with trapping on concurrent or consecutive nights.

Criteria , Sub-criteria and Categories Significance rating

j. Electrofishing rate. A sample of native fish containing three or more species

k. Regionally rare fauna (excluding 2,3a/b, or 4g). Over 5 individuals (or >1% of the total population or highest known population density in NEM).

4k. Regionally rare fauna (excluding 2,3a/b, or 4g). >5 individuals (or >1% of the total population or highest known population density in NEM).

l. Regionally restricted fauna (excluding 2, 3a/b or 4g). Over 10 individuals (or >1% of the total population or highest known population density in NEM).

4l. Regionally restricted fauna (excluding 2, 3a/b or 4g). >10 individuals, >1% of population or highest population density in NEM.

- * For birds and fish, this only includes resident or breeding populations or repeated (or likely repeatable) feeding or roosting observations of migratory/nomadic species in natural habitat.
- ** Excluding the Common Froglet and Spotted Marsh Frog.
- *** Excluding seabirds and international migratory waders.
- **** Excluding Silver Gulls and White-throated Needletails or woodswallows seen in passage.

App 1.3a

Common Name	Scientific Name	Status		Distribution										Habitat Type																	
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																
BIRDS																															
EMUS—DROMAIDAE																															
Emu	<i>Dromaius novaehollandiae</i>		X							X																					
QUAILS—PHASIANIDAE																															
Stubble Quail	<i>Coturnix novaezelandiae</i>		M	MU	ML	PL	yl	PU	p	y	n	n	P	-			r		-	-	-	P	l	m	G	S	w	a	p		
Brown Quail	<i>Coturnix australis</i>		R4/M	mu	ml	-	yl	pu	-	y	-			-			-		-				l	-	-	s	w	-			
BUTTON-QUAILS—TURNICIDAE																															
Painted Button-quail	<i>Turnix varia</i>		R5/M				-		-	y	n	n	p	h	k				h	u	t	b	i	-	-					-	
Little Button-quail	<i>Turnix velox</i>		R1/M	-	-										-				-							-	-				
Red-chested Button-quail	<i>Turnix pyrrhotorax</i>	Ins	R1/M	-	-	-																									
PLAINS-WANDERER—PEDIONOMIDAE																															
Plains-wanderer	<i>Pedionomus torquatus</i>	Vul	R1/M	-	-																										
PIGEONS and DOVES—COLUMBIDAE																															
Peaceful Dove	<i>Geopelia placida</i>		R1/M				-	-																		-					
Common Bronzewing	<i>Phaps chalcoptera</i>			-	-	yl	pu	P	Y	N	N	P	H	K		d	R	H	u	T	B	I	E	p	l	m	-		-		
Brush Bronzewing	<i>Phaps elegans</i>		R5				-	-	Y	n	n	-	H	K	C	D	R	h	t	-	-	-	-	m					-		
Crested Pigeon	<i>Ocyphaps lophotes</i>		R2		-	pl		pu	-															p	l				f		
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>		R1												-																
Rock Dove	<i>Columba livia</i>	Intr		mu	ml	PL	YL	PU	P	Y	n	n	P		-				r					e	P	L	-		a	F	
Spotted Turtle-Dove	<i>Streptopelia chinensis</i>	Intr	Verm	mu	ml	PL	YL	PU	P	Y	n	n	P		-				r	-				i	e	P	L	-		F	
RAILS, CRAKES and SWAMPHENS—RALLIDAE																															
Lewin's Rail	<i>Rallus pectoralis</i>	Rare	R2/M		-		yl	-	-	-	-														l	-		w	-		
Buff-banded Rail	<i>Rallus philippensis</i>		R4/M	mu	ml	-	yl	pu	p	y	-				-										l	-	s	w	a	-	
Australian Spotted Crake	<i>Porzana fluminea</i>		R3	-	ml	pl	yl	pu	p	y	-								r						l	-		w	a		
Baillon's Crake	<i>Porzana pusilla</i>	Ins	R2/M				-	-	-																						
Spotless Crake	<i>Porzana tabuensis</i>		R2/M	-	-		yl	-	-	-																		w	-		
Black-tailed Native-hen	<i>Gallinula ventralis</i>		R2/M				-	-	-	-																					
Dusky Moorhen	<i>Gallinula tenebrosa</i>			mu	ml	pl	YL	pu	P	Y	N	n	P	h	-				R						L	m		W	A	f	
Purple Swamphen	<i>Porphyrio porphyrio</i>			mu	ml	pl	YL	pu	p	Y	n	n	p	-					r						l	m		W	A	-	
Eurasian Coot	<i>Fulica atra</i>		M	mu	ml	pl	YL	pu	P	Y	n	-	P	h	-				-						-	-		W	A	-	
GREBES—PODICIPEDIDAE																															
Great Crested Grebe	<i>Podiceps cristatus</i>		R3/M				-	-	-																						
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>			-	ml	pl	YL	PU	P	Y	n	-	P	h	-				R						L			W	A	f	
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>		M	-	ml	-	yl	PU	P	y	-		P	h	-										-			w	a	-	

Common Name	Scientific Name	Status		Distribution											Habitat Type																							
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F						
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																							
Grey Teal	<i>Anas gibberifrons</i>		M	mu	ML	pl	yl	PU	P	y	-	-	P	h	-																		w	A	-			
Australasian Shoveler	<i>Anas rhynchos</i>		R3/M	-	ml	-	-	pu	p	-	-	-	p	h																			-	w	a			
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>		R3/M	-	-	-	-	-	-	-	-	-	p	-																				-	a			
Freckled Duck	<i>Stictonetta naevosa</i>	Rare	R1/M	-	-	-	-	-	-	-	-	-	-	-	-																				-			
Hardhead	<i>Aythya australis</i>		R3/M	-	ml	-	-	pu	p	-	-	-	p	h																				-	w	a		
Blue-billed Duck	<i>Oxyura australis</i>	Rare	R3/M	-	-	-	-	pu	p	-	-	-	p	h																					-	a		
Musk Duck	<i>Biziura lobata</i>		R3/M	-	-	-	-	pu	p	y	-	-	-	-	-																				-	a		
Mallard	<i>Anas platyrhynchos</i>	Intr	Verm	-	-	-	yl	-	-	y	-	-	-	-	-																				w	a	f	
HAWKS, EAGLES and KITES—ACCIPITRIDAE																																						
<i>Hawks</i>																																						
Spotted Harrier	<i>Circus assimilis</i>		R2/M	-	-	-	-	-	-	-	-	-	-	-	-																							
Swamp Harrier	<i>Circus aeruginosus</i>		R4/M	mu	-	-	-	pu	-	-	-	-	p	-																						s	a	
Grey Goshawk	<i>Accipiter novaehollandiae</i>	Rare	R1/M	-	-	-	-	-	-	-	-	-	-	-	-																							
Brown Goshawk	<i>Accipiter fasciatus</i>			-	ml	pl	-	pu	p	y	n	n	p	h	k	c	d	r	h	-	t	b	i	e	p	l	-	-							a	-		
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>		R3			-	yl	pu	p	y	n	-	-	-	-	-	-	r	h																w	a		
<i>Eagles</i>																																						
Wedge-tailed Eagle	<i>Aquila audax</i>		B	-	-	-	-	-	-	y	n	n	p	h	k	-	d	r	h																			
Little Eagle	<i>Hieraaetus morphnoides</i>		R5/B	mu	ml	pl	-	-	p	y	-	-	p	-	-																					a		
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Rare	R1/V																																			
<i>Kites</i>																																						
Whistling Kite	<i>Haliastur sphenurus</i>		R4/B	-	-	pl	-	pu	-	y	-	-	p	-																						r		
Black Kite	<i>Milvus migrans</i>		R2/MB	-	-																																	
Square-tailed Kite	<i>Lophoictinia isura</i>	Vul	R1/V																																			
Black-shouldered Kite	<i>Elanus notatus</i>		M	mu	ml	pl	yl	pu	p	y	-	-	p																							p	l	
Letter-winged Kite	<i>Elanus scriptus</i>	Rare	R1/V																																			
FALCONS—FALCONIDAE																																						
Australian Hobby	<i>Falco longipennis</i>		R5/B	-	-	pl	yl	-	p	y	n	-	p	h	k	-	r	-																			e	p
Peregrine Falcon	<i>Falco peregrinus</i>		R4/B	-	-	-	yl	pu	p	y	-	-	-	h	k	-	-	r																				e
Black Falcon	<i>Falco subniger</i>	Rare	R2/B	-	-	-	-	-	-	-	-	-	-	-	-																							
Brown Falcon	<i>Falco berigora</i>			nu	ml	pl	-	pu	p	y	-	-	p	-	-																							r
Nankeen Kestrel	<i>Falco cenchroides</i>		M	mu	ml	pl	yl	pu	p	-	-	-	p																									p
OWLS—STRIGIDAE																																						
Southern Boobook	<i>Ninox novaeseelandiae</i>			-	-	pl	-	pu	p	y	n	n	-	h	k	c	d	r	h	u	t	b	i	e	p	-	-											
Barking Owl	<i>Ninox connivens</i>	Rare	R2/B			-	-	-	y	-	n	-	-	-	k																							
Powerful Owl	<i>Ninox strenua</i>	Rare	R4/B			-	-	-	y	-	n	-	-	h	k	c	d	r	h																			

Common Name	Scientific Name	Status		Distribution											Habitat Type																		
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F	
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																		
BARN OWLS—TYTONIDAE																																	
Barn Owl	<i>Tyto alba</i>		R5/M	mu	ml	pl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	f
Masked Owl	<i>Tyto novaehollandiae</i>	Rare				-			-	-	-	-																					
Sooty Owl	<i>Tyto tenebricosa</i>	Rare	R1/B																														
LORIKEETS—LORIIDAE																																	
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>		R5/B		-		YL		P	y	n		p		-		R	h			-	i	-	P	l	m						F	
Scaly-breasted Lorikeet	<i>Trichoglossus chlorolepidotus</i>	Esc					yl		p	-	-						r					-	p	l								f	
Musk Lorikeet	<i>Glossopsitta concinna</i>		M	-	ml	PL	YL	PU	P	y	n	-	P	-	-		R	-			-	l	-	P	l							F	
Purple-crowned Lorikeet	<i>Glossopsitta porphyrocephala</i>		R5/MB		ml	PL	yl	PU	P	-	-		P				r					l	-	P	l							F	
Little Lorikeet	<i>Glossopsitta pusilla</i>		R5/MB		ml	pl	yl	pu	p	y	n		p				r	-				-	i	e	p	l						f	
COCKATOOS—CACATUIDAE																																	
Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii</i>	End	R1/M							x		-									-	-	-										
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>		M/B			-	-	pu	p	y	N	n	p	H	K	C	D	r	H	u	T	b	i	-	-	-						F	
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>		M/B	-		-	yl	PU	p	y	N	n	p	H	K	C	D	R	H	u	t	b	i	e	p	l	-					F	
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>			mu	ml	PL	yl	PU	p	y	n	n	P	H	K	c	d	R	h	-	t	b	i	e	P	L	m	g				F	
Major Mitchell Cockatoo	<i>Cacatua leadbeateri</i>	Rare	R1/V			x																											
Little Corella	<i>Cacatua sanguinea</i>		R3/B		-	PL	-	pu	p	y	n	n	p	-	-		r	h				-	-	P	l	-	g					f	
Long-billed Corella	<i>Cacatua tenuirostris</i>		R5/B	-	ml	PL	-	PU	p	y	n	-	P	-			r	-				-	-	-	P	L	-	g				F	
Galah	<i>Cacatua roseicapilla</i>			MU	ML	PL	YL	PU	P	y	n	n	P	-	-		R	-				-	-	-	P	L	-	g	s	w		F	
LONG-TAILED PARROTS—POLYTELITIDAE																																	
Cockatiel	<i>Nymphicus hollandicus</i>		R1/MB			-		-	-																								
Superb Parrot	<i>Polytelis swainsonii</i>	Vul	X		x	x	x	x	x													x	x	x									
Australian King-Parrot	<i>Alisterus scapularis</i>		R4/MB			-	-	-	-	y	-	-	p	h	k	c	d	r	-			-	-	-	-	-							-
BROAD-TAILED PARROTS—PLATYCERCIDAE																																	
Crimson Rosella	<i>Platycercus elegans</i>		M	-	-	-	yl	PU	p	Y	N	N	P	H	K	C	D	R	H	u	t	B	l	e	p	l	m	-	-			f	
Eastern Rosella	<i>Platycercus eximius</i>			mu	ml	PL	YL	PU	P	Y	N	N	P	h	k			R	H			-	B	l	E	P	L	m	g			f	
Australian Ringneck	<i>Barnardius zonarius</i>	Esc				-	yl	-	-	-	n	-	p				r	-				-		-								-	
Red-rumped Parrot	<i>Psephotus haematonotus</i>			mu	ml	PL	YL	PU	P	-	n	-	p				r						-	P	L	-						f	
Swift Parrot	<i>Lathamus discolor</i>	Vul	R4/M				yl		p	y	-	-	-				r					-	l	-	p	l						f	
Turquoise Parrot	<i>Neophema pulchella</i>	Rare	R1/V																														
Blue-winged Parrot	<i>Neophema chrysostoma</i>		R2/MB		-	-	-																										
Budgerigar	<i>Melopsittacus undulatus</i>		R1/MB																														
FROGMOUTHS—PODARGIDAE																																	
Tawny Frogmouth	<i>Podargus strigoides</i>			mu	ml	pl	yl	pu	p	y	n	n	p	h	k	c	d	r	h	u	t	b	i	e	p	l	m	-	-				f

Common Name	Scientific Name	Status		Distribution												Habitat Type																	
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F	
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																		
<i>Pseudemoia group</i>																																	
Spencer's Skink	<i>Pseudemoia spenceri</i>		R3																														
Tussock Skink	<i>Pseudemoia pagenstecheri</i>		R5	MU	ML	PL	yl	-	p																								
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>		R3																														
Glossy Grass Skink	<i>Pseudemoia rawlinsoni</i>	Ins	R2																														
Coventry's Skink	<i>Niveoscincus coventryi</i>		R3																														
Metallic Skink	<i>Niveoscincus metallicus</i>		R2																														
Eastern Three-lined Skink	<i>Bassiana duperreyi</i>			mu	ml	pl	-		p	y	n	n	p	H	K	C	D	r	h	u	t	b	i	e	p	l	-	g	-	-	-	-	
ELAPID SNAKES—ELAPIDAE																																	
Eastern Small-eyed Snake	<i>Rhinoplocephalus nigrescens</i>		R3																														
White-lipped Snake	<i>Drysdalia coronoides</i>		R3																														
Little Whip Snake	<i>Suta flagellum</i>		R5	mu	ML	pl	-		-																								
Tiger Snake	<i>Notechis scutatus</i>			mu	ml	pl	yl	pu	p	Y	n	n	p	h	k	c	d	r	h	-	t	b	i	e	p	l	M	g	s	W	a	f	
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>		R4	-	ml	-	-	-	-	-	-	-	-																				
Eastern Brown Snake	<i>Pseudonaja textilis</i>			mu	ml	pl	yl	pu	p	y	n	n	p	h	k	-	r	h	u	t	b	i	e	p	l	m	g	s	w	a	-		
Lowland Copperhead	<i>Austrelaps superbus</i>			mu	ml	-	-	pu	p	Y	n	N	p	H	K	c	d	R	H	u	T	b	i	e	p	l	M	g	s	W	a	-	
AMPHIBIANS																																	
GROUND FROGS—MYOBATRACHIDAE																																	
Victorian Smooth Froglet	<i>Geocrinia victoriana</i>																																
Bibron's Toadlet	<i>Pseudophryne bibronii</i>		R4	mu	ml	pl	-	pu	p	-	n	p																					
Southern Toadlet	<i>Pseudophryne semimarmorata</i>		R5																														
Plains Froglet	<i>Crinia parinsignifera</i>		R3	MU	ml	pl		PU																									
Common Froglet	<i>Crinia signifera</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	h	k	c	d	R	h	-	-	-	E	P	L	M	G	S	W	A	F		
BULLFROGS—CYCLORANINAE																																	
Southern Bullfrog	<i>Limnodynastes dumerilii</i>			mu	ml	pl	yl	PU	P	Y	N	N	P	h	k																		
Striped Marsh Frog	<i>Limnodynastes peronii</i>		R5	mu	ml	pl	-	pu	p	y	n	n	p	h	k	-	-	r	h	-	-	-	p	l	m	-	w	a	-				
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																		
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>		R5	MU	ML	pl	-	pu	p																								
TREE FROGS—HYLIDAE																																	
Lesueur's Frog	<i>Litoria lesueuri</i>		R2																														
Peron's Tree Frog	<i>Litoria peronii</i>		R2																														
Growling Grass Frog	<i>Litoria raniformis</i>			MU	ML	pl	yl	pu	P	Y	n	n	p	-	-																		
Southern Brown Tree Frog	<i>Litoria ewingii</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	H	K	C	D	R	H	t	b	i	E	P	L	M	G	S	W	A	F		
Verreaux's Tree Frog	<i>Litoria verreauxii verreauxii</i>			mu	ml	pl	yl	pu	P	Y	N	N	P	H	K	C	D	R	H	-	-	-	e	p	l	M	g	s	W	A	f		

Common Name	Scientific Name	Status		Distribution												Habitat Type																
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																	
<i>Pseudemoia group</i>																																
Spencer's Skink	<i>Pseudemoia spenceri</i>		R3																													
Tussock Skink	<i>Pseudemoia pagenstecheri</i>		R5	MU	ML	PL	yl	-	p																							
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>		R3																													
Glossy Grass Skink	<i>Pseudemoia rawlinsoni</i>	Ins	R2																													
Coventry's Skink	<i>Niveoscincus coventryi</i>		R3																													
Metallic Skink	<i>Niveoscincus metallicus</i>		R2																													
Eastern Three-lined Skink	<i>Bassiana duperreyi</i>			mu	ml	pl	-		p	y	n	n	p	H	K	C	D	r	h	u	t	b	i	e	p	l	-	g	-	-	-	
ELAPID SNAKES—ELAPIDAE																																
Eastern Small-eyed Snake	<i>Rhinoplocephalus nigrescens</i>		R3																													
White-lipped Snake	<i>Drysdalia coronoides</i>		R3																													
Little Whip Snake	<i>Suta flagellum</i>		R5	mu	ML	pl	-		-																							
Tiger Snake	<i>Notechis scutatus</i>			mu	ml	pl	yl	pu	p	Y	n	n	p	h	k	c	d	r	h	-	t	b	i	e	p	l	M	g	s	W	a	f
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>		R4	-	ml	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Eastern Brown Snake	<i>Pseudonaja textilis</i>			mu	ml	pl	yl	pu	p	y	n	n	p	h	k	-	r	h	u	t	b	i	e	p	l	m	g	s	w	a	-	
Lowland Copperhead	<i>Austrelaps superbus</i>			mu	ml	-	-	pu	p	Y	n	N	p	H	K	c	d	R	H	u	T	b	i	e	p	l	M	g	s	W	a	-
AMPHIBIANS																																
GROUND FROGS—MYOBATRACHIDAE																																
Victorian Smooth Froglet	<i>Geocrinia victoriana</i>																															
Bibron's Toadlet	<i>Pseudophryne bibronii</i>		R4	mu	ml	pl	-	pu	p	-	n	n	p	H	K	C	D	R	H	t	-	-	-	-	-	-	-	-	-	-	-	
Southern Toadlet	<i>Pseudophryne semimarmorata</i>		R5																													
Plains Froglet	<i>Crinia parinsignifera</i>		R3	MU	ml	pl		PU																								
Common Froglet	<i>Crinia signifera</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	h	k	c	d	R	h	-	-	-	-	-	-	-	-	-	-	-		
BULLFROGS—CYCLORANINAE																																
Southern Bullfrog	<i>Limnodynastes dumerilii</i>			mu	ml	pl	yl	PU	P	Y	N	N	P	h	k																	
Striped Marsh Frog	<i>Limnodynastes peronii</i>		R5	mu	ml	pl	-	pu	p	y	n	n	p	h	k	-	-	r	h	-	-	-	-	-	-	-	-	-	-	-	-	
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																	
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>		R5	MU	ML	pl	-	pu	p																							
TREE FROGS—HYLIDAE																																
Lesueur's Frog	<i>Litoria lesueuri</i>		R2																													
Peron's Tree Frog	<i>Litoria peronii</i>		R2																													
Growling Grass Frog	<i>Litoria raniformis</i>			MU	ML	pl	yl	pu	P	Y	n	n	p	-	-																	
Southern Brown Tree Frog	<i>Litoria ewingii</i>			MU	ML	PL	YL	PU	P	Y	N	N	P	H	K	C	D	R	H	t	b	i	E	P	L	M	G	S	W	A	F	
Verreaux's Tree Frog	<i>Litoria verreauxii verreauxii</i>			mu	ml	pl	yl	pu	P	Y	N	N	P	H	K	C	D	R	H	-	-	-	-	-	-	-	-	-	-	-	-	

Common Name	Scientific Name	Status		Distribution											Habitat Type																									
		Vic	GM	VP			AP		LH			UH		R		C	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F								
				MU	ML	PL	YL	PU	P	Y	N	N	P	H	K																									
WANDERERS, BROWNS and XENICAS—NYMPHALIDAE																																								
<i>Danaids</i>																																								
Wanderer	<i>Danaus plexippus plexippus</i>		Vag		-	-		-	-	-	-	-																												
Lesser Wanderer	<i>Danaus chrysippus petilia</i>		Vag		-	-	-	-	-	-																														
<i>Satyrinids</i>																																								
Cyril's Brown	<i>Argynnina cyrila</i>		Y						-	y	n	N	p	H	K	c	D	r	H	U	t	b	-	-																
Southern Ringed Xenica	<i>Geitoneura acantha ocrea</i>		Y	-			yl	pu	P	Y	N	N	P	H	K	c	D	R	H	U	T	B	I	E	p	I	M													
Klug's Xenica	<i>Geitoneura klugii klugii</i>		Y	-	-	-	-	-	P	Y	N	N	P	H	K	c	D	R	H	U	T	B	I	E	p	I	M													
Bank's Brown	<i>Heteronympha banksii banksii</i>		R5						-	-	y	-	n	-	h	k	c	d	r	h	-																			
Common Brown	<i>Heteronympha m. merope</i>		Y	MU	ML	PL	YL	PU	P	Y	N	N	P	H	K	c	d	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F								
Spotted Brown	<i>Heteronympha paradelpha</i>		R4						-	Y	-	n	-	h	k	c	d	r	h	t																				
Shouldered Brown	<i>Heteronympha penelope</i>		Y	-		-	-	pu	P	Y	N	N	P	H	K	c	D	R	H	U	T	B	I	e	p	I	M													
Bright-eyed Brown	<i>Heteronympha cordace cordace</i>		R1																																					
Kershaw's Brown	<i>Oreixenica kershawi</i>		R3																																					
Common Silver Xenica	<i>Oreixenica lathoniella herceus</i>		R3																																					
Sword-grass Brown	<i>Tisiphone abeona</i>		R5/Y																																					
<i>Charaxinids</i>																																								
Tailed Emperor	<i>Polyura pyrrhus sempronius</i>		Vag																																					
<i>Nymphalids</i>																																								
Australian Admiral	<i>Vanessa itea</i>		Y	-	-	-	yl	pu	p	Y	n	N	p	H	K	C	D	R	h	-	t	b	i	E	p	I	M													
Australian Painted Lady	<i>Vanessa kershawi</i>		Y	MU	ML	PL	YL	PU	P	Y	N	N	P	H	K	c	D	R	H	U	T	B	I	E	P	L	M	G	S	W	A	F								
Meadow Argus	<i>Junonia villida calybe</i>		R5	mu	ML	pl	yl	pu	p	y	n																													
AZURES, COPPERS and BLUES—LYCAENIDAE																																								
<i>Azures</i>																																								
Dark Purple Azure	<i>Ogyris abrota</i>		R5				-	yl	-	p	y	n	n	p	h	k																								
Genoveva Azure	<i>Ogyris genoveva araxes</i>		Vul	R1/Y																																				
Olane Azure	<i>Ogyris olane ocela</i>																																							
<i>Coppers</i>																																								
Bright Copper	<i>Paralucia aurifer</i>		R2																																					
Eltham Copper	<i>Paralucia pyrodiscus lucida</i>		End	R1																																				
Small Copper	<i>Lucia limbaria</i>		R4	mu	ml	pl	-	-	-	-																														
<i>Blues (group associating with ants)</i>																																								
Large Ant-blue	<i>Acrodipsas brisbanensis cyrilus</i>		Vul	R1/Y																																				

APPENDIX 1.3. SUMMARY OF FAUNA RECORDED FROM NORTH EAST MELBOURNE
with Conservation Status, Distribution and Habitat Type

LEGEND

Status: Victoria [categories taken from CNR (1995)]	
Ext	Extinct in Victoria
End	Endangered
Vul	Vulnerable
Rare	Rare and at risk
Ins	Insufficiently known (suspected to be either Rare, Vul or End)
R/C	Restricted colonial roosting or breeding site species
IMA	Shorebird protected under International Migratory Agreement
Intr	Introduced species
Status: Greater Melbourne (GM)	
R1	Occurs in 1 to 9 GM 2' grids
R2	Occupies threatened/disjunct habitats in 10 to 39 GM 2' grids
R3	Occupies non-threatened habitats in 10 to 39 GM 2' grids
R4	Occupies threatened/disjunct habitats in 40 to 79 GM 2' grids
R5	Occupies non-threatened habitats in 40 to 79 GM 2' grids
X	Extinct in GM
Vag	Vagrant to GM
M	Migratory or nomadic species
B	Significant breeding bird of prey or parrot
Y	Hill-topping butterfly
Verm	Vermin species in native vegetation
Esc	Escaped, released or re-introduced species
Distribution by biophysical zone: (based on survey data)	
VP	Volcanic Plains: MU (Merri Upland), ML (Merri Lowland) or PL (Plenty Lowland)
AP	Alluvial Plains: YL (Yarra Lowland) or PU (Plenty Upland)
LH	Lowland Hills: P (Plenty), Y (Yarra) or N (Nillumbik)
UH	Upland Hills: N (Nillumbik) or P (Plenty)
R	Ranges: H (Hume) or K (Kinglake)
Habitat Type/Community Number: (based on survey data)	
C:1,2,3	Cool temperate rainforest, wet forest or damp riparian forest
D:4	Damp sclerophyll forest
R:5,10,28	Riparian forest, gully woodland or swampy riparian woodland
H:6,31	Herb-rich foothill forest or valley forest
U:8,19	Heathy forest or upland scrub
T:9,21	Heathy woodland or damp heath
B:11	Box-stringybark woodland
I:12	Box-ironbark woodland
E:13,20,29	Escarpment woodland, cliff/escarpment shrubland or granite hills woodland
P:7,14,15	Riverine forest, grassy woodland or sand-plain woodland
L:16,18,24,30	Floodplain riparian woodland, riparian scrub or drainage line woodland/herbfield
M:17,27	Swamp scrub or swampy woodland
G:22,23	Grassland including native species dominated grazing land
S:25.2/3/8	Grassy/gilgai seasonal wetland (volcanic plains)
W:25.4-7,26	Watercourse/floodplain natural seasonal/permanent wetland
A:25.1/7,26	Artificial waterbody, aqueduct, tunnel, mine or quarry
F:	Farmland, orchard, shelterbelt, plantation, town or parkland (< 10% native cover)
Note: Upper-case letter denotes common or widespread occurrence. Lower-case letter denotes uncommon or restricted occurrence. Dash denotes rare, localised or vagrant occurrence.	

APPENDIX 2.1 Craigieburn Grassland and the Proposed ERA

Pursuit of Craigieburn Grassland as a biological reserve. There are insufficient biological reserves containing extensive and intact stands of volcanic plains grassland. The State Government Grasslands Conservation Strategy recommended the establishment of several grassland reserves. Craigieburn Grassland is the most significant site for grassland flora and fauna on the volcanic plains of south-western Victoria. It is the best option for a volcanic plains biological reserve. It will require ongoing protection of external habitat links and implementation of grassland conservation management.

Protection of Craigieburn Grassland can only be assured if it is set aside as a biological reserve. Only then can effective management of the grassland be undertaken. There is accord amongst grassland ecologists that Craigieburn Grassland needs to be incorporated as a biological reserve. Much effort has been invested into scientific research and planning in pursuit of this goal. For some years negotiations have been underway to buy the land from Craigieburn Clay. Means to obtain money from Federal Government, State Government, Whittlesea Council and various granting sources are being determined. All bodies have shown support for the proposal. The Federal Government and Shire of Whittlesea have expressed an interest in financial support. If this can be matched by the State Government, acquisition of the grassland could occur. The Department of Natural Resources and Environment is involved in co-ordinating the process. It is essential that acquisition can be achieved without further delays.

The designation of Craigieburn Grassland within a conservation area (stretching from south of Barry Road to Craigieburn Road East) will be necessary if it is to be protected from future urban growth and development. The Craigieburn Grassland/O'Herns Road Wetlands is the crucial part of the Merri Creek Conservation Area. It supports the most extensive, intact, rare, diverse and significant volcanic plains rocky grassland, stream and wetland flora and fauna assemblage in GM. Further it lies within the significant Kilmore Gap biogeographic system. No biological reserve containing both of these systems is in existence.

Conservation of the fauna and flora needs to be the primary land-use consideration. There is high potential for scientific research and scope for environmental education, rehabilitation and management as a volcanic plains grassland reserve. This is due to the extent and diversity of intact volcanic plains habitats, connectivity of buffering rural zone land to the east and relative isolation from settlement.

Much depends on the future of the Merri Freeway proposal. A decision on this proposal needs to be reached before land acquisition can be finalised. The Federal Government has also offered funding to Vic Roads for the freeway.

The siting of a freeway at Craigieburn Grassland has resounding environmental impact and this study recommends that other alternatives be considered.

- 1 On primary flora and fauna survey evidence Craigieburn Grassland is the most significant area of cool temperate grassland in Victoria. This landscape and ecosystem is globally threatened. The site potentially has world heritage values.
- 2 The freeway would dismember the Merri Creek Strategic Habitat Link (as the Hume Freeway has dismembered western habitat links). Disturbance and habitat loss from the freeway would have a great impact on the highly significant Merri Creek streamway and O'Herns Road Wetlands (site 12). It would isolate Merri Creek from the Summer Hill drainage line. This would cause insurmountable blockages to movements of ground fauna between these significant areas.
- 3 The freeway would prevent the incorporation of Craigieburn Grassland as the Grassland Ecological Reference Area. This is the highest priority and conservation ranking Ecological Reference Area proposed for North East Melbourne.
- 4 Construction and impact of the freeway would severely encumber the biological values, ecosystem function and management options of the grassland as a biological reserve.

Establishment of a Volcanic Plains Ecological Reference Area (ERA). Craigieburn Grassland and O’Herns Road Wetlands form the proposed ERA for volcanic plains grassland and riparian ecosystems in NEM. The primary recommendation of the NEROC study and Regional Habitat Link/Hydrological Strategies is the establishment of the Craigieburn Grassland and O’Herns Road Wetland sites as an ERA (see Executive Summary). The proposed Volcanic Plains ERA offers:

- The most representative area for grassland ecosystems remaining on the volcanic plains of GM (and possibly Victoria).
- The most biologically significant, diverse, intact and extensive area of volcanic plains landforms/habitats in GM (and possibly Victoria).
- The best opportunity for long-term preservation and scientific research of grassland ecosystems in GM.

No area of intact and extensive volcanic plains landform/habitat occurs on public land in NEM (or elsewhere). Craigieburn Grassland is presently being considered for acquisition as a grassland reserve. This would enable it to meet the public land eligibility requirement for designation as an ERA. There are specific conservation and research oriented guidelines for ERAs (in accordance with the Regional Habitat Link and Hydrological Strategies). The negotiation of conservation covenants or similar conservation agreements as to the management of the adjoining land in the Edgars Creeks Headwaters site to the east would be desirable (see conservation measures). Suggested requirements/conditions for ERAs would include:

- no permanent dwellings, public roadways or service easements (unless already approved or present)
- no mining, logging and other primary production uses, native vegetation or substrate removal, alteration to the hydrological cycle, land-fill tipping, chemical usage, intensive or non-passive recreational activities or burning, unless required under prescribed management
- restriction of public access to specific research, management and nature interpretation
- employment of research-based conservation practices.

The proposed ERA requires ongoing conservation management including revegetation and weed and vermin control programs. It has compatible use for research and has opportunity for controlled, low intensity nature interpretation by the public. The proposed ERA is one of only two areas in GM where the vulnerable Plains-wanderer and Striped Legless Lizard are each known to occur. It also supports the endangered Southern Lined Earless Dragon. Populations of these species over most of their range in GM have been eliminated by habitat loss or modification and fox predation.

Their long-term survival will require specific management, including protection from interference by the public. Scientific monitoring (including permanent herpetofauna pitfall lines) in areas containing populations of these threatened species is recommended. Management of adjoining farmland to the east (Edgars Creek Headwaters site, which is known to contain the Striped Legless Lizard and almost certainly the Plains-wanderer) should be sympathetic to the conservation of flora and fauna in the proposed ERA.

The sites for the proposed ERA contain the Merri Creek streamway and the extensive areas of grassland to the east between Cooper Street and Craigieburn Road East.

Designated threatened, depleted or disjunct landform, habitat, assemblage or species categories in the proposed ERA include:

- Stony knoll grassland and cliff/escarpment shrubland: rocky grassland ground fauna assemblage including the Red-chested Button-quail, Southern Lined Earless Dragon, Striped Legless Lizard, Fat-tailed Dunnart and grassland passerine birds such as the Zebra Finch; basalt cliff and stony knoll flora.
- Plains grasslands and seasonal wetland: stony–gilgai–silt plains ground fauna assemblage including the Plains-wanderer, Little Button-quail, birds of prey and frogs; scurf-peas and swamp wallaby-grasses.
- Summer Hill drainage line: marshland flora including the Curly Sedge and brackish herbfield flora.
- River gorge–riffles–pools: riparian scrub herpetofauna including the Red-bellied Black Snake, avifauna such as the Spotless Crake and Freshwater Blackfish; riparian flora.
- Seasonal wetland (O’Herns Road Swamp; 25.2/25.7). Waterbirds including the Black-winged Stilt and cover-dependent marsh birds such as the Latham’s Snipe (O’Herns Road Swamp qualifies as significant

migratory bird habitat requiring protection under international agreement), Brown Quail, Buff-banded Rail, Striated Fieldwren and Swamp Harrier.

- Permanent wetland/submerged herbfield (O'Herns Road Quarry 26.1). Waterbirds, particularly waterfowl including the Freckled and Blue-billed Ducks and frogs, particularly the Growling Grass Frog.

Appendix 2.2 Plenty–Merri River Red Gum Protection Zone—significant habitat protection

Most of the woodland east of the Epping–Woodstock Road was placed in a Red Gum Protection Zone to be managed for conservation purposes under the statutory planning framework of state and local government authorities (MPE Plenty Corridor Strategic Plan, 1989; MPE 1990). The NEROC study proposes that the zone be extended to include all significant stands of River Red Gum and associated native grassland on the Plenty/Merri Plains as they form an integral biological system. Eligibility is met for sites in this study with fauna or habitat attributes assessed as State or High significance.

Areas meeting this stand/significance criteria are contained in the Fenwick and Surrounds, Summerhill Road, Edgars Creek Headwaters, Mernda to Yan Yean and Dunnetts Road Swamp sites. This is the largest area of River Red Gum grassy woodland in GM and possibly the largest supporting a native field layer on private land in Victoria. Land-use management which enables habitat protection and enhancement in accordance with the regional habitat link and hydrological strategies (Volume 1) needs to be implemented over the whole area. Management needs to provide specific protection and provision for regeneration of significant areas of River Red Gums, rocky grassland and marshland. The River Red Gums will require ongoing management to break the tree dieback cycle.

Of critical importance to the site is to devise a system which protects sensitive and significant areas from livestock grazing pressure. This will protect rare plants and enable natural regeneration, replanting of eucalypts and native understorey habitat and land protection works (weed/erosion control). Areas are localised (creeks) and widespread (stony knolls/swales and grassy woodland stands). A system of land management is required under the River Red Gum Protection Zone (MPE 1990). This aims to improve the long-term viability of the River Red Gums and their associated grasslands and fauna and reduce levels of habitat loss and degradation. The primary purposes of the zone are:

- to protect and provide for regeneration of existing trees and the ultimate re-establishment of a cover of River Red Gums and sections of shrubland over cleared land
- to achieve farm management that incorporates sustainable nature conservation and land protection practices
- to conserve indigenous flora and fauna so that the viability of any natural ecosystem is not threatened
- to ensure that land use activities and land management practices are consistent with the conservation of natural resources.

As a Strategic Habitat Link and River Red Gum Protection Zone, properties should be eligible for land protection and conservation management incentives. These should include rate rebates (e.g. redirecting the rate money into land protection/conservation works). Land protection projects will need to be supported by financial and technical assistance. Materials for fencing will be required for protection of watercourses, tree planting and natural regeneration projects. Research to identify the areas of highest biological significance or sensitivity will be required so that effective and informed conservation planning and action can be undertaken.

Suggested conditions for rebate would be the implementation of appropriate conservation practices such as the establishment of revegetation and regeneration plots which are linked effectively to each other and negotiation of conservation covenants or protection agreements for native habitats and their fauna. The conservation management of the grassy woodland habitat should be actively encouraged. These actions are considered critical to the long-term viability of fauna in the region.

Broad-acre traditional farming and seasonal grazing rotation benefits flora and fauna conservation. Native habitat has been better protected by traditional broad-acre farms than by modern subdivision farms. Farm subdivision and intensification has led to greater levels of habitat loss, fragmentation and degradation. The River Red Gum Protection Zone requires that all stands of River Red Gum containing a native grassland dominated field layer in the site to be protected and managed for conservation. Grazing of

marshland areas should be restricted to summer–autumn and grassland areas to winter–spring. Grassland animals such as quail would benefit if an extensive block of grassland is left ungrazed in spring.

Substantial areas of native grassland vegetation occur on the broad-acre mixed farms. Most have relatively intact stony knolls of Kangaroo Grass and swales of Brown-back Wallaby-grass, Common Blown Grass and Common Wallaby-grass. Some large mixed farms such as Fenwick Stud, where rocks have afforded protection from grazing support extensive areas of Kangaroo Grass. This habitat supports the Red-chested Button-quail and potentially the Striped Legless Lizard, especially when under a light grazing regime and seasonally spelled. Areas where rock walls are present may support the Southern Lined Earless Dragon. Each of these fauna species is vulnerable while breeding to loss of grassland cover.

On the above basis, continued restriction of broad-acre subdivision is recommended for the site. With planning and management, the existing broad-acre farms have far greater scope to incorporate sustainable conservation management practices than could be obtained if the zoning were changed and rural subdivision occurred. Broad-acre farm subdivisions may incorporate deleterious management practices such as removal of rock and native grassland so as to promote the pasture required to cater for increased livestock grazing levels. These practices would be deleterious to most of the significant faunal species present.

Rocks left on traditional farms critical for ground fauna and flora. The broad-acre farms contain extensive stony knolls. Nine volcanic plains grassland reptile species were recorded on the stony knolls. These include substantial populations of the Large Striped Skink, Bougainville's Skink and Tussock Skink and smaller populations of the Cunningham's Skink and Little Whip Snake, and where ground logs are present, the Eastern Three-lined Skink. The stony knolls support significant assemblages of rare native herbs (e.g. Tough Scurf-pea) as do adjoining swales and gilgais (e.g. Hairy Weather-glass). Some of the more protected knolls support low shrubs (e.g. Common Everlasting and Smooth Rice-flower). Fencing should be erected around several areas supporting the significant knolls and swales.

APPENDIX 4.1

Conservation measures under the Regional Habitat Link Strategy: Melbourne Parks & Waterways management

Plenty Gorge Park Master Plan. Melbourne Parks & Waterways have made substantial progress regarding management and conservation issues in Plenty Gorge Park. Natural and cultural heritage studies have been undertaken and written, a background paper has been prepared and a master plan has been formulated for the park. The objective of the master plan is to provide long-term strategies for development and management which maintain and enhance the values and features of the park.

A key objective of the Master Plan is the establishment of effective and integrated conservation management throughout the site. Conservation issues are raised and strategies and actions are devised and implemented. Implementation of the strategy is to be monitored to judge how effectively it solves problem issues. The background paper presented for the Plenty Gorge Park states that the park's primary aims are to achieve the long-term protection of the landscape and environment of the Plenty Gorge and to provide a recreation resource for northern Melbourne (Melbourne Water 1991).

The Yarrambat site is the most significant biological area in NEM and one of the most significant in Victoria. Negative impacts from land-use on adjoining freehold land and visitor use on flora and fauna conservation and landscape values need to be addressed. The most important management issues in the site are listed below.

Establishment of the Yarrambat–Morang Wetlands Ecological Reference Area (ERA)

The majority of the site is proposed for conservation management (see planning recommendations site 40) The proposed ERA contains the river and adjoining bushland from Smugglers Gully to Yarrambat falls and the adjoining Morang Wetlands. Restricted public access conditions should apply. Proposed plans for visitor use of the Plenty Gorge Park must exclude this section of the river as it contains threatened populations of the Platypus and Freshwater Blackfish. Instream studies, including follow-up electrofishing surveys, should be undertaken.

The long-term viability of the significant flora and fauna populations present in the ERA will require specific management and protection from interference by the public. The Yarrambat ironbarks form the study site of an ongoing research program on nectar production and honeyeater feeding ecology. It is the most important site in GM for the endangered Regent Honeyeater. The success of these studies will require security from intruder access and interference. All escarpment areas, particularly the Silurian sandstone, are considered too sensitive to permit uncontrolled human disturbance.

The Shire of Nillumbik needs to withdraw public access into the Ecological Reference Area from Yarrambat Park. Fishing should be excluded from the pools in this section. The Freshwater Blackfish has reached a critically low population level which will not withstand further angling pressure.

The Morang Wetlands will require minimum disturbance from visitor use in the park. The wetland may ultimately become the most important waterbird area in NEM. It must achieve full sanctuary status to achieve this aim.

Fauna studies as a basis for conservation strategies

Research needs to be undertaken into the management of faunal species and habitats of significance, their threatening processes and conservation measures for short-term population maintenance and long-term population viability. Surveys should provide the supportive data to key recommendations in a series of conservation strategies which aim to maximise faunal values. The draft strategies should be disseminated amongst the local residents and conservation groups for cooperative feedback and formulation of final recommendations. Discussion of draft strategies should coincide with workshops reviewing the research behind the strategies. These would

promote an awareness of environmental research and the principles of 'hands-on' land protection and conservation techniques amongst landowners.

Conservation of areas of highest biological value—primary land management priority

This is particularly relevant to the reference stands of Manna Gum floodplain riparian woodland and Muttonwood riparian scrub along the river. It also includes the Red Ironbark–Yellow Gum box–ironbark woodland at Yarrambat ironbarks and seasonal and permanent wetlands of Morang Wetlands. In order to maintain these areas, disturbance should be minimised and management works, including weed control, revegetation and rare plant protection programs (e.g. kangaroo/rabbit fences), should be maximised.

Fire protection and management—fire buffer zones

There was a severe bushfire in the Kurrak Road site in 1980 and houses were lost. The proximity of houses in combination with the north–south orientation of the gorge, rugged and inaccessible terrain, high fuel loads on the grassy western escarpments and scrubby eastern escarpments and increasing visitor usage gives the area one of the highest fire hazard ratings in NEM.. The residents are living in a potential fire trap, unless sensible fire precautions are taken. Guidelines should be devised that address biological and human safety requirements. A Fire Protection Plan containing strategic fire breaks and access points has been devised in conjunction with local CFA brigades. Sections should be designated in habitat links that could be safely removed as fire breaks by earth moving machinery in the path of a fire . When planning the establishment of habitat links, a preference on fire safety grounds should be given to east–west, rather than north–south links. The latter create potential 'fire wicks'.

The focus of the strategy should be on fire prevention for residential areas and farm and bushblock dwellings near the Plenty Gorge Park and fire management of native vegetation patches and habitat links. At present, fire is considered undesirable in the gorge as previous fires appear to have locally eliminated rare faunal species, particularly through promoting the spread of environmental weeds (e.g. Montpellier Broom and Gorse) which eliminate native understorey plants. Mosaic burning trials with follow-up weed control along the lines conducted at Gellibrand Hill Park may need to be implemented. A system of perimeter buffer zones using existing cleared land also needs to be implemented. Controlled burning practices for habitat enhancement and a fire safety and awareness public education program should be conducted.

Visitor use, park interpretation and community education

The biological and physical diversity, landscape drama and cultural heritage of the Yarrambat site provides opportunity for interpretation and education facilities. The area offers a broad spectrum of community interests and activities. The focus for visitors should be on understanding the natural resources of the park. An additional focus for locals should be the promotion of sustainable bushland management practices and lifestyles in keeping with these practices (particularly with regard to the environmental impact of settlement in the gorge).

Visitor resource centre

A central visitor resource centre containing environmental education brochures, kits and booklets and, ideally, an indigenous plant nursery that is open to the public would be valuable. Information available should include wetland conservation and development, river ecology and its threatening processes, the ironbark avifauna, volcanic plains flora and fauna and their conservation and threatening processes, fire safety and management, land protection activities including drainage, erosion, weed and vermin control, ecologically sustainable land management practices and urban growth impacts (e.g. responsible pet ownership).

Access, activities and nature trails

Environmental education and natural and cultural heritage tour programs should be devised. A system of restricted access areas and controlled access points which protect habitat and maintain faunal values with the use of walking trails and public interpretation and viewing facilities should be devised for the Plenty Gorge Park. A

series of low key picnic facilities could be developed. Consideration of low conflict locations with fauna and flora and controls on visitor-use capacity and public safety aspects will be critical.

Guidelines will be required for managing significant stands of habitat along the river and adjacent bushland escarpments which are being (or are likely to be) subjected to increased levels of human activity. State Government policy may require a linear trail connecting the Yarra Valley Park. The steep, rugged and more fragile terrain of the eastern side of the gorge is unsuitable for the trail. General access should remain restricted in sections of the river between the junction of Smugglers Gully and Yarrambat falls as this is the most secluded section of the park. The steep slopes of this section of the gorge buffer it from residential and farmland areas and offer 'wilderness values' in the regional context.

Private landowner environmental awareness

There is a feeling amongst landowners that they can perform adequate land protection and conservation management practices. This author views the present private land management as inadequate for the conservation of native species (particularly in areas of tree planting and weed, pest, erosion and effluent control). Guidelines on conservation management should be prepared for landowners of abutting private land. This should contain advice on the biological values of the land, land conservation management and habitat protection, the desirability of conservation covenants or other permanent protection and the eligibility for sustainable land management and habitat protection incentives. The focus should be on integrating works with those being undertaken in the park and the value of active conservation and land protection works such as fencing and revegetation, weed eradication and protection of sensitive or significant vegetation (e.g. fragile escarpments). Landowners on the habitat links should be encouraged to undertake conservation management of their land as outlined in the preceding strategies.

APPENDIX 4.2 Morang Wetlands Development

The area supports the broadest diversity of wetland habitat types and fauna in NEM. Most of the structural development of the wetlands has been completed. The combined water area of the half dozen wetlands is over 25 ha. Key issues are the protection of sanctuary values for waterbirds, revegetation and weed control programs.

Visitor use of the area will require strict control. Many wetland species (e.g. Black-winged Stilt and Australian Shelduck) require seclusion while breeding. Low key interpretation under ranger supervision could be provided with the establishment of a wetland conservation nature trail and suitable screening vegetation and bird hides. The wetland areas are considered unsafe for uncontrolled public use. Vehicles (other than management), horse and bike riders and dogs should not be permitted.

Morang Wetlands Development Objectives

- To raise the viability of the wetlands as habitat for breeding populations of birds and their prey.
- To strengthen the role of the wetlands in the seasonal movements and usage of local waterbirds.
- To develop guidelines for a program of introduction of native wetland vegetation, habitat substrates, fish and other prey species.
- To provide a focus for wetlands education in northern Melbourne.

North East Wetland

A channel was excavated in the late 1980s, diverting Wilton Vale Creek into the North East Wetland. Previously, the quarryhole only carried seasonal water. It now forms a permanent, large and shallow waterbody which is developing into an excellent waterbird area. When fully established it will provide prime habitat for waterfowl and waders. Water area is 8–10 ha and the wetland is classified as a shallow freshwater marsh. Apart from the southern (overflow) arm which is about 3 m, the maximum depth is around 2 m and the average depth is 0.5–1 m. Common open water species of waterfowl and large waders such as the Eurasian Coot, Australasian Grebe, Hoary-headed Grebe, Masked Lapwing, White Ibis, White-faced Heron, Australian Wood Duck, Pacific Black Duck and Grey Teal quickly colonised the wetland. Some these have commenced breeding. As the submerged and emergent herbfield vegetation develops, crakes and rails, additional waterfowl and possibly, international migratory waders, will visit the wetland.

Habitat enhancement works at the North East Wetland

Despite the substrate being blasted basalt rock supporting minimal soil, submerged herbfield vegetation (particularly Blunt Pondweed, Swamp Lily and Red Milfoil) is developing extensively in the shallows of the northern section. The wetland appears ready for the introduction of Southern Pygmy Perch, Australian Smelt and Freshwater Blackfish (requires lengths of PVC pipe for breeding to be placed in the southern arm). This wetland would be an ideal site for introduction of the vulnerable Dwarf Galaxias. Expert advice from NRE freshwater fish ecologists and appropriate permits (see site 26) should be sought regarding the suitability and availability of other native species such as the vulnerable Yarra Pigmy Perch. Successful establishment in a biological reserve would provide a valuable conservation measure for these species. The fish would attract more substantial populations of the Rufous Night Heron, cormorants, Darter, Australian Pelican and Great Crested Grebe.

After slowly filling for some years, the desired level of the North East Wetland was established. Trees and shrubs were planted around the high water level of the northern section. Soil from Wilton Vale Marsh was deposited on the basalt shoreline to promote herbfield development. Emergent rocks provide waterbird roosts and additional placement of logs, branch debris and fallen trees in the shallows would provide feeding habitat and cover for native fish and frogs. This would enhance the nutrient turnover and the development of habitat for detritus feeders such as crustaceans which form important prey for waterbirds.

Copses of Swamp Paperbark should be planted to provide cover and breeding habitat for waterbirds and marshland passerines. Planted emergent semi-aquatics such as the Tall Spike-sedge are already being utilised for

nesting by Eurasian Coots and Purple Swamphens. As this establishes, it will attract the Little Bittern and other cover-dependent species. When soil formation develops mudflats in the extensive shallows, the North East Wetland will provide excellent shorebird habitat.

Mother-In-Law's Leap

This provides the main breeding area for Hardheads and Blue-billed Ducks in the Morang Wetlands. The wetland is classified as a deep freshwater marsh. Water area is 8–10 ha and the floor is relatively flat and deep (over 6 m) with steep sides. Aquatic vegetation is restricted to the shallower northern arms and to within about 2 m of the edge of the deep water. It has scope for revegetation and habitat enhancement of the shallows and cliffs. The water conductivity level of 3,200 ms (brackish) may be unsuitable for re-introduction of most species of freshwater fish apart from the Common Galaxias.

Wilton Vale Marsh

Construction was modelled on Dunnetts Road Swamp at Yan Yean and Castle Flat at the north end of Yan Yean Reservoir. Water area is over 5 ha. The wetland is classified as a shallow freshwater marsh with extensive freshwater meadows. The marsh was designed to provide seasonal wetland habitat, to augment the permanent quarryhole wetland habitat of Mother-In-Law's Leap and North East Wetland. The first stage was excavated in November 1992. This is immediately inside the park from Wilton Vale Road. Topsoil was scraped back over about 2 ha and water diverted from Wilton Vale Creek created a shallow seasonal wetland with a muddy substrate, of depth of 15 to 50 cm.

Waterplants rapidly established from pools in Wilton Vale Creek and the surrounding quarryholes. Yellow-billed Spoonbills and White-faced Herons commenced visiting soon after inundation from winter rains in 1993. When visited in early October 1993, Wilton Vale Marsh already supported a substantial frog population and semi-aquatic insects such as dragonflies were establishing. Initially the wetland drained back into Wilton Vale Creek and dried out by early summer. A regulated take-off point and levee bank to stop the backflow was constructed. Within two years the wetland supported high prey diversity, extensive herbfield cover and over 30 species of waterbirds.

The second stage of construction occurred in February 1995. The area to the south of the first stage formed an extensive low-lying section of Toowoomba Canary-grass. This contained a few River Red Gums. Another 2–3 ha was scraped and open water channels (about 1.5 m deep) and two islands containing the red gums were created to improve waterbird habitat. The channels may deter foxes from disturbing nesting waterbirds on the islands. The third stage was completed in April/May 1996. A carriageway/levee bank between the north and south sections was dismantled, the southern section was deepened and extended and the banks of the wetland were tapered. At high water, the marsh overflows into grassy wetland amongst River Red Gums before returning to Wilton Vale Creek and then onto North East Wetland.

River Red Gum and Blackwood are regenerating. Thickets of Silver Wattle, Swamp Paperbark, Prickly Tea-tree and Golden Spray should be planted around the wetland fringe and the large island to create roosts for species such as the Nankeen Night Heron and nest sites for waterfowl (e.g. Musk Duck). Areas of Toowoomba Canary-grass need to be replaced by Common Tussock-grass. As tall emergent herbfields develop (e.g. Tall Spike-sedge) additional waterbird species (e.g. Lewin's Rail, Little Bittern, Spotless Crake and possibly, the Baillon's Crake) will be attracted. Dead trees and nesting platforms (such as at Lake Borrie on the Werribee Sewage Farm) could be provided to promote nesting cormorants and waterfowl such as the Australian Shelduck and Chestnut Teal. Additional basalt boulders and logs should be provided for waterbird roosts. Piles of branch debris would enable the subsequent introduction of the Southern Water Skink and the rare Glossy Grass Skink.

Wilton Vale Marsh provides secure breeding habitat for waterfowl and prime cover and feeding habitat for waders. It supports one of the most extensive stands of Rush Sedge seasonal wetland and Blunt Pondweed permanent wetland in NEM. The submerged herbfields are particularly important for waterfowl. While inundated, the fringing mudflats and freshwater meadows provide productive amphibian and crustacea habitat. These form prey for large marshland waders including herons, spoonbills, ibis and particularly, the Latham's Snipe.

Wilton Vale Marsh was designed to attract shorebirds. The muddy substrate and deeper water aquatic herbfields are highly productive for invertebrates and frogs. In normal or wet years as the water recedes over summer-autumn, the drawdown extends slowly over about 20 m. The upper half of the ebb becomes too dry for aquatic plants but inundation over winter-spring prevents terrestrial plants from colonising due to waterlogging. Ground level, semi-aquatic freshwater meadow vegetation (Matted Water Starwort, Waterwort, Small Mud-mat, Austral Mudwort, etc.) 'chases' the receding water over the mudflats. This creates invertebrate prey and shorebird feeding habitat. To achieve this, gently-pitched banks of less than 5° and an ability to regulate the annual winter-spring high water and summer-autumn drawdown cycle each to about six months is required.

Another requirement is that the wetland becomes dry or almost dry in low rainfall years. This prevents aquatic plants from taking over the drawdown area and allows terrestrial plants to advance. When it is re-inundated, a release of nutrients from decomposing plant material (detritus) enables a burst in invertebrate and aquatic plant growth. This is referred to as the boom-bust cycle which is a feature of ephemeral inland Australian swamps, lacking from permanent wetlands in southern Victoria.

APPENDIX 4.3 Melbourne Parks & Waterways management

Expansion of the Plenty Gorge Park. Much of the Plenty side of the river is presently protected from escalating subdivision and housing development as it is incorporated into the Plenty Gorge Park, forms Proposed Public Open Space (MPE 1990) or is a proposed Conservation Zone. Melbourne Parks & Waterways is acquiring sections for inclusion into the park. There has been acute habitat loss and disturbance associated with the development on the Blossom Park side of the river. Land acquisition and park access issues on land to the east of the river are being formulated so that Melbourne Parks & Waterways can expand habitat and land protection activities in this section. As soon as this occurs several important management issues need to be resolved. They are listed below.

Full resourcing of the operation of the Plenty Gorge Park

This study endorses LLC Melbourne Area 2, General Recommendation I for parks in urban areas: 'That the authorities responsible for managing (in the PGP case, MP&W) and protecting (in the PGP case, MP&W and NRE) public land and water resources be allocated the resources necessary for the task'. Lack of resources has been a primary reason why adequate levels of operation have not been maintained in these areas in recent years.

Establishment of the Plenty–Janefield Ecological Reference Area (ERA)

The majority of the Plenty–Janefield site should be utilised for conservation management purposes. A substantial component of this is contained within a proposed Ecological Reference Area (see planning recommendations) in which restricted public access conditions should apply. The land adjoining Oatland Road and on Whittlesea Properties (zoned conservation and should be included as PPOS) is designated as the Ecological Reference Area buffer zone. This area requires ongoing management including revegetation and weed control programs. It has compatible use for low intensity passive recreation by the public, particularly in the area of nature interpretation. Fire breaks and access tracks should be located external to the ERA.

The ERA supports a significant butterfly and orchid assemblage and contains several endangered and vulnerable and numerous regionally threatened species. Populations of many of these species elsewhere in GM have been eliminated over recent decades. Their long-term survival will require specific management and protection. The Yellow Gum census plot at Goldsworthy Lane is the subject of a long-term research program on Swift Parrot nectar feeding ecology. Herpetofauna pitfall sites should be established on the Quaternary volcanics at R&D. The success of these studies will require security from intruder interference, uncontrolled fires and disturbance.

Erection of a predator fence

The fence is required at R&D, Blossom Park and Janefield to exclude human and companion animal access to the gorge from residential areas. A 2 m high chain wire mesh fence with inverted top and outward vermin apron to isolate Blossom Park from the Plenty River was part of the conditions of agreement between developers and Melbourne Parks & Waterways as an essential element of the habitat buffer. Access into the gorge has placed conflicting pressures on flora and fauna conservation and is inadvisable due to the sensitive and dangerous nature of the escarpments. The siting of the predator fence needs to be carefully planned. Emergency and management gates must be permanently closed. Erection of the fence commenced in 1993, but sections are still to be completed.

Exclusion of horse riding

The Ecological Reference Area is considered too significant and sensitive to permit horse riding and any other active recreation. Bridal paths will need to be restricted to low impact/significance areas to the west of the river (e.g. outside the predator fence in the Blossom Park buffer zone). No bridal paths should be established

to the east of the Plenty River as these would impact on significant habitat designated as the Ecological Reference Area buffer zone. Disturbance and weeds incurred from horse riding conflicts with the management requirements of the reference area buffer zone. Strict adherence to bridle path conditions on the western side of the predator fence will be necessary as will signs and public education.

Exclusion of trail bikes and cattle grazing

Livestock enter the proposed Ecological Reference Area from adjoining freehold. Fences need to be made more secure and landowners will be required to prevent livestock transgressions.

The proposed Blue Lake Environmental Education Centre (EEC)

Existing access and facilities and the landscape and biological features of the Blue Lake area offer high potential as an environmental education centre. However, biological significance, environmental sensitivity and public safety aspects render the area unsuitable for high use or unsupervised public access. The area offers one of the best potential outdoor environmental education complexes in Greater Melbourne. Town planning approval has yet to be granted for the operation of the EEC and full establishment of programs have yet to be formalised. Subject to approval, the programs should be fully integrated with the purposes of essential and appropriate conservation management works of the Plenty Gorge Park. The major issue is that activities must not extend into highly significant habitats beyond the Blue Lake property boundaries.

The EEC lies in a proposed Ecological Reference Area (see planning recommendations) and activities would require strict supervision and monitoring. The Blue Lake and Dry Quarry offer opportunities for training in orienteering skills. Satisfactory safety and land protection arrangements would need to be provided in public access areas at the EEC. The impact of abseiling and filming should be closely monitored. Quarryface users will be required to take greater care not to dislodge slabbing rocks as these may contain roosting bats. The ledges and crevices in the exposed shale rockfaces are undergoing gradual regeneration by Yellow Gum woodland vegetation. This slow healing process will continue if quarryface disturbance is kept to a minimum. Significant or sensitive areas should be identified and protected from disturbance. The EEC requires extensive weed control and indigenous revegetation programs.

Cave-bat grill and research/monitoring required at the Janefield Mine

Humans enter the mine and have disturbed the colony of Common Bent-wing Bats. This appears to have caused most of the population to abandon the roost. Small numbers remain, but evidence from the abundance of droppings is that at some time (probably up to the beginning of recent development five years ago) it supported a substantial population of bats. The mine contains sections of deep water and has potential for cave-ins. The population of cave-bats utilising the mine needs to be determined through monitoring and research. A grill to prevent unauthorised access from humans, which does not interfere with the passage of bats should be constructed.

APPENDIX 4.4

The Little Watsons Creek Reservoir/Lower Yarra Scheme

There are two proposed stages to the Scheme. Stage 1 is increasing the pumping capacity of the Yering Pump Station and treatment capacity of the Winneke Purification Plant. Stage 2 is the development of a water storage on Watsons Creek—the Little Watsons Creek Reservoir. Relevant quotes from *Melbourne Water Resources Review 1992*.

- ‘There would be strong local objection to the second stage of the scheme’.
- ‘That the second stage of the Lower Yarra Scheme should be put on hold until after the findings of the Land Conservation Council on the Melbourne Area, District 2 are made available’.

In the event of the reservoir proposal lapsing (which has now occurred), it is reported that there was an agreement between Melbourne Water (then a government department) and the Shire of Eltham to transfer the land to NRE as an extension to Warrandyte State Park. The situation is now stalemated, as the new charter of the corporate body is to sell the land. It is vital that a mutual agreement is reached.

Regional Habitat Link Strategy—likely environmental effects of the Little Watsons Creek Reservoir

Loss of a large area of native habitat in a site of high faunal and faunal habitat significance. The Little Watsons Creek Reservoir is indeed large (relative to Sugarloaf Reservoir) and, it is estimated, would flood much of the bushland in the site.

Severance or substantial disruption in the connectivity of the most significant, contiguous and functional ranges to plains habitat link/faunal corridor in Greater Melbourne. There would be substantial disruption to fauna movements between several sites of significance. **Loss of an opportunity to enhance/revegetate this habitat link and faunal corridor.**

Loss of an opportunity to provide an effective nature conservation link between existing parks of high conservation and public utility value and biological significance (Kingleake, Warrandyte and Yarra Valley). This biological reserve system would be the only one in Victoria linking mountain wet and damp sclerophyll forests through foothill dry sclerophyll forest and box–stringybark woodland to lowland grassy and floodplain riparian woodlands. A biological reserve system containing this diversity and rarity of habitat types and range in flora and fauna would be unique in Victoria. The proximity and utility of this park to a metropolis adds to its significance as a Natural Heritage Area.

Regional Hydrological Strategy—likely environmental effects of the Little Watsons Creek Reservoir

Loss or substantial disruption to a significant and vital instream fauna/habitat link in the Yarra Basin. Watsons Creek is the most intact and important second order stream for vertebrate fauna in the Middle and Lower Yarra. All others have been eliminated or substantially degraded.

Altered seasonal stream flow and output of cold, poorly oxygenated water. This may disrupt the instream ecosystem of lower sections of Watsons Creek. The instream fauna of the creek in areas under the direct effect of the Sugarloaf Reservoir (downstream of Sugarloaf Creek and Stevenson Creek) is of noticeably inferior quality. Watsons Creek has a water salinity problem to which an additional dam could contribute. Research is needed on whether the salinity is from groundwater percolating under pressure from Sugarloaf Reservoir. Moderately saline water is pumped from the Yarra River. This may concentrate in the sediments of the reservoir. A further water storage of Yarra River water may prove highly undesirable on these grounds.

There are periodic discharges in the lower Watsons Creek of unknown origin, but presumed to be from the Sugarloaf Reservoir. This should be investigated to establish the origin of the water and determine its effect on the stream ecosystem. The colour and odour of this discharge water and the rise in algal level in the water in the

lower section of the creek is a major concern and is likely to be the reason for the poor results at the electrofishing site under Oxley Bridge.

Until a satisfactory Environmental Impact Assessment and accountable hydrological/water quality study of the Sugarloaf Reservoir on the Watsons Creek ecosystem is provided, the conservative approach should be to hold the proposal for an additional storage reservoir in the system in abeyance.

Loss of instream fauna. The construction of the Little Watsons Creek Reservoir would eliminate the Broad-finned Galaxias from the stream.

Other Issues

The need for the Little Watsons Creek storage dam should be quickly resolved. The dam proposal is, perhaps, unnecessary, given proposed extensions to the Melbourne water supply elsewhere, and not welcomed by the local community (Melbourne Water Resources Review Interim Report). Relevant quotes from the *State Conservation Strategy* 1987 would indicate that the storage location, given the biological significance of the inundation/impact area, is inappropriate:

- ‘Instream dam construction will also be avoided where possible and any new dam proposals will require an environmental assessment and an assessment of needs and alternatives. The Government will only approve the withdrawal of water from rivers and any form of dam construction after ensuring that a flow pattern is maintained which provides for existing instream uses such as aquatic ecosystems and canoeing’.
- ‘Modifications such as fish ladders ... will be required’. This is particularly relevant given the presence of a potentially threatened migratory fish species in the creek (Broad-finned Galaxias) and the potential for the vulnerable Australian Grayling to utilise the stream with the fish-way installation at Dights Falls.
- ‘The Government will require all new diversions and abstractions of water from rivers to accommodate the flow patterns necessary to minimise the impact on downstream ecosystems’.
- The Government will require the design of all on-stream dams to maintain water quality sufficient to protect downstream ecosystems, particularly with respect to temperature and oxygen levels’.

Covenanting of Melbourne Water land. If the Little Watsons Creek Reservoir proposal does not go ahead and in the event that Melbourne Water pursues land disposal, any land contained within the site of significance should only be sold with an appropriate Conservation Covenant on the title.