EPA VICTORIA

Best Practice Environmental Management

Environmental Guidelines for Major Construction Sites

Environmental Guidelines for Major Construction Sites

Environment Protection Authority
477 Collins Street, Melbourne
Victoria 3000 AUSTRALIA

February 1996

ISBN

CONTENTS

FOREWORD

Major construction projects, such as roads and freeways, are important to Victoria's economic development. During construction, however, such projects pose a significant risk to the environment, which must be addressed by developers and contractors.

Construction practices that fail to control pollution can cause damage to waterways and wetlands, kill fish, upset aquatic ecological systems and wildlife communities, and result in contamination of land and groundwater. The risk to the environment is particularly high when work is done near coastal areas, streams and creeks, or along a river valley. When construction occurs near built-up areas, poor practices may result in air and noise pollution which may cause annoyance and affect the health of neighbouring communities.

This document is designed to provide developers and contractors with guidelines on how to implement sound practices that minimise environmental impacts and eliminate health risks and nuisance to residents near a construction site.

There are also sound economic reasons for implementing good environmental practices during major construction projects. Excessive sedimentation of waterways can cause flooding, require expensive dredging of navigation channels downstream or reduce the capacity of downstream water storage units, destroy valuable wetlands, and reduce commercial and recreational fishing. On-site, loss of topsoil means importation of replacement topsoil at substantial cost. Where construction activities cause a nuisance, this places a cost on the community through loss of amenity.

Construction sites are constantly changing, and systems need to be in place to modify control measures to maintain their effectiveness. Therefore, frequent inspection and monitoring is required to continually check the effectiveness of measures.

I would encourage all companies involved in the design and construction of major roads and development projects to use these *Guidelines*.

Best Practice Environmental Management publications are produced by Environment Protection Authority (EPA) to encourage a pro-active approach to environmental management by industry.

EPA would be pleased to receive comments on these *Guidelines* from the construction industry and other interested parties.

Brian Robinson
Chairman
Environment Protection Authority

1 PURPOSE AND APPLICATION

The *Environmental Guidelines for major Construction Sites* provides a useful source document to help prepare and implement a environmental management plan for major constructions sites.

The purpose of these *Guidelines* is to provide developers, contractors and government agencies involved with commissioning or constructing freeways, major roads or major development projects with:

- information how to avoid and minimise environmental impact, which is preferable to the less cost-effective option of controlling or treating discharges to the environment, or undertaking remedial action.
- information on the likely impact of construction activities on the environment and how this is to be assessed
- guidelines for undertaking risk assessment and management
- a clear statement of environmental performance objectives for each segment of the environment
- suggested best practice environmental measures to meet the performance objectives based on available experience

The *Guidelines* provide contractors and developers with a framework within which due diligence obligations can be met and environmental damage can be avoided.

The *Guidelines* are not prescriptive or detailed. Application will require tailoring them to particular site conditions and making adjustments if the measures listed are inappropriate to the site.

Many of the measures proposed in the *Guidelines* are also applicable to smaller construction sites (less than five hectares) and should be used where appropriate to avoid and minimise impact from such activities.

The *Guidelines* do not refer to State legislation, regulations or environmental policies. Developers, contractors and subcontractor, when they are used, must make themselves aware of their legal obligations because they are responsible for compliance.

Legislative requirements and standards are minimium standards, and projects should endeavour to continually improve on these standards.

2 PRE-CONSTRUCTION PLANNING AND DESIGN

Integrating environment protection at the project planning stage ensures that measures to avoid and minimise pollution can be built into the project design and work schedule. This approach is more cost-effective than establishing controls once the project commences.

Once a site has been selected, it is necessary to conduct an environment assessment that identifies which parts of the environment may be vulnerable to damage from construction activities.

Making a risk assessment is a useful way in which to approach this aspect of site management. Environmental risk deals with the probability of an event causing an undesirable effect. There are three elements to consider when defining risk[1]. They are:

- a time frame over which the risk or risks are being considered
- a probability of the occurrence of one or more events
- a measure of the consequences of those events

Based on the site assessment, project design information and the construction work program, a risk assessment of all aspects of the project can be executed. This assessment in turn leads to a strategy to manage all significant risks to the environment.

2.1 Environmental assessment

Understanding which segments of the environment are vulnerable is a prerequisite to identifying and managing environmental risks.

The assessment should not only consider the environmental impacts on a site, but whether or not off-site effects are possible.

An initial assessment of the site should be conducted to identify sensitive environmental areas or uses that require protection. These may include:

- sensitive or endangered flora and fauna
- aquatic plants and animals, if a natural waterway is affected
- groundwater recharge areas

Depending on whether or not the construction site is near houses, schools or hospitals, the impact of air discharges, noise and vibration on the health and amenity of adjacent residents will need to be included in the assessment.

Once the project has been approved, but before construction commences, it is important to initiate an environmental monitoring program to collect baseline data on all sectors of the environment.

---

1 T. Beer & F. Ziolkowski, *Environmental risk assessment: an Australian perspective*, Supervising Scientist Report 102, 1995.

ENVIRONMENTAL ASSESSMENT

Objective

To identify or obtain information on any relevant environmental impact that the construction project may cause.

Suggested measures

- Identify sensitive environmental areas or uses that may be affected by construction activities.
- Identify whether residents adjacent to the site could be affected by pollution from construction activities or suffer reduced amenity.
- Monitor baseline air and water quality and ambient noise levels adjacent to the construction site.
- Conduct an assessment of expected noise levels from construction activities which may affect the surrounding community.
- Conduct a desk study to identify potentially contaminated sites in the construction area, and sample and analyse soils that are suspected of being contaminated before construction commences.

2.2 Risk assessment

Risk assessment is defined as the identification and characterisation of the nature of existing and potential adverse effects to humans and the environment resulting from exposure to environmental hazards.

Risk is a function of the probability of an event occurring and the degree of damage that would result should it happen.

Information from the environment assessment is required in order to conduct a risk assessment. Details of the project design and the work program are also needed.

The assessment allows significant risks to be identified so that they can be targeted for action.

This initial risk assessment needs to be regularly reviewed. An ongoing risk assessment is therefore an integral part of the Environmental Management System (see section 3.1). This involves a review of existing risks and identification of new risks detected through the surveillance or monitoring program.

Risk assessment can be divided into six steps.

Information gathering

A risk assessment requires information about site conditions. This information is used in conjunction with information collected during the environmental assessment (see section 2.1).

The following information needs to be collected before construction commences:

- a map of soil types and their erosion potential
- climate, weather patterns and stream flows
- topography and natural geographic features (including whether site is in a floodplain)
- the construction schedule
- changes to the topography of the site during each stage of the project
- a map of existing vegetation identifying areas to be retained
- details of areas of cleared land at each stage of the development, and period of time that each section will be exposed
- changes to drainage and identification of sources of clean and contaminated stormwater

- calculation of stormwater flows within micro-catchments within the site, based on a one-in-two-year storm event (two-year ARI with intensity of six hours), for each stage of the project

- location of stockpiles, batters, haul roads and cuts

- nature and location of works that will occur within 50 metres of a natural waterway or other sensitive environmental area

Hazard identification

Hazard identification involves identifying activities that could lead to an adverse effect on the environment, impair human health, result in a nuisance, or decrease the amenity of residents adjacent to a construction site.

It is necessary to consider both direct and potential causes of hazard, which could cause water, air, land or noise pollution. Hazards may arise out of features of the site, or the nature of construction activities. For example, clearing vegetation from large areas and exposing erodible soil is a high-risk activity which may lead to dust generation and sediment run-off.

Proposed pollution prevention and control measures should be considered when identifying hazards, because if they fail, there will be an adverse impact on the environment.

Hazard analysis

Hazard analysis considers the likelihood of an environmental hazard being realised.

This analysis is based on previous experience, historical data for the failure rate of structures and systems, and includes the impact of site-specific conditions which may influence risk levels. For example, if large areas of land are cleared of vegetation, the probability of a stream crossing collapsing is low, while the potential for dust problems is high.

The level of risk is also a function of time. The longer a risk is allowed to continue, the more likely it is that there could be an undesirable consequence.

Consequence analysis

Consequence analysis determines the effect on the environment should a risk be realised. For example, if a temporary river crossing should collapse it could be disastrous for a waterway. The failure of a sediment fence will have less impact on the river.

Two factors that should be considered in the consequence analysis are:

- significant long-term consequences, such as permanently altering the ecology of an environmental system

- significant short-term consequences, where the effects are temporary

The consequence analysis is independent of the probability of an event occurring.

Determining the overall risk

The overall risk is a function of the probability of a measure, structure or system failing, or of an event or activity causing environmental damage, and the magnitude of the environmental damage, should it fail.

Determining risk levels is an iterative process. The objective of the process is to reduce risk to acceptable levels by implementing an action plan.

Ranking

Wherever possible, risks should be quantified using scientific data, experience and judgement. Unfortunately, when risk assessment methodology is applied to construction activities, many risks cannot be quantified because of the lack of historical data. In addition, site-specific factors, such as site topography, have a major effect on risk levels.

The magnitude of the risk is either estimated or ranked in order of importance. Ranking involves listing risks relative to one another, from high to low.

Ranking risks, based on uncertain and limited data, requires a high degree of judgement. It is therefore important that this step is conducted by an expert with experience in assessing risks on major construction sites.

Rankings need to be reviewed as actions are taken to eliminate or reduce the risk.

RISK ASSESSMENT

Objective

To identify and rank all potential risks that may arise from the construction of major projects.

Suggested measures

- Collect all relevant information needed to conduct a risk assessment of construction activities.
- Identify, assess and rank risks to all segments of the environment, human beings, nuisance and loss of amenity from plans of the proposed development.
- Once construction commences, review the risk assessment as risk management strategies are implemented, inspection or monitoring identifies new risks or when there are changes to the project.

2.3 Risk management

Risk management is the development of an action plan, including measures and strategies, which reduces significant risks to acceptable levels.

Risk management should be applied to pre-construction planning for the most cost-effective environmental outcomes.

Risk assessment and management should be continually updated during the construction phase.

Precautions and measures to prevent environmental problems are preferred to structural controls that either reduce or control risks.

Avoiding risks

The most effective approach is to avoid risk by modifying the design. Selecting a route that bypasses a sensitive environmental area, avoiding areas with high erosion potential, or retaining existing topography wherever practical rather than undertaking major land-shaping, are examples of risk avoidance.

Reducing risks

There are several strategies that can be implemented to reduce environmental risks.

For example, sequence works so that small sections of the site are worked on at any one time. If rehabilitation is commenced immediately works are completed, the risk of erosion, contaminated run-off and dust is reduced. Keeping haul roads to a minimum and routing them to avoid erodible areas, such as sloping terrain, will also help reduce dust and erosion problems. Another way of reducing risk is to avoid scheduling works on areas that pose a very high risk of erosion during periods when heavy rains and strong winds are expected.

These are some of the approaches that can be taken to reduce risk.

- Increase inspection, surveillance and monitoring frequency so that new or underestimated risks are quickly identified and managed, and any failures or imminent failures in controls are promptly identified and repaired.
- Implement a preventative maintenance program for pollution-control installations to reduce the risk of equipment failure.

- Implement contingency plans, such as ensuring that corrective action on a failing control measure is prompt. Such contingency plans will reduce the environmental impact of a hazard.

Controlling risks

It is possible to manage risks by installing control measures. For example, by constructing a sediment pond it is possible to trap silt and treat contaminated water. Paving haul roads to reduce the generation of dust is another control which can be adopted.

Large structural controls need to be planned and installed before construction commences. These include, but are not restricted to, sediment retention basins and artificial wetlands to treat contaminated stormwater, and structures to reduce water velocities.

As a general principle, various sediment interception and control devices should be installed as close to the source as possible. For example, install wheel washes and rumble grids to prevent dirt being taken off-site rather than instituting road sweeping.

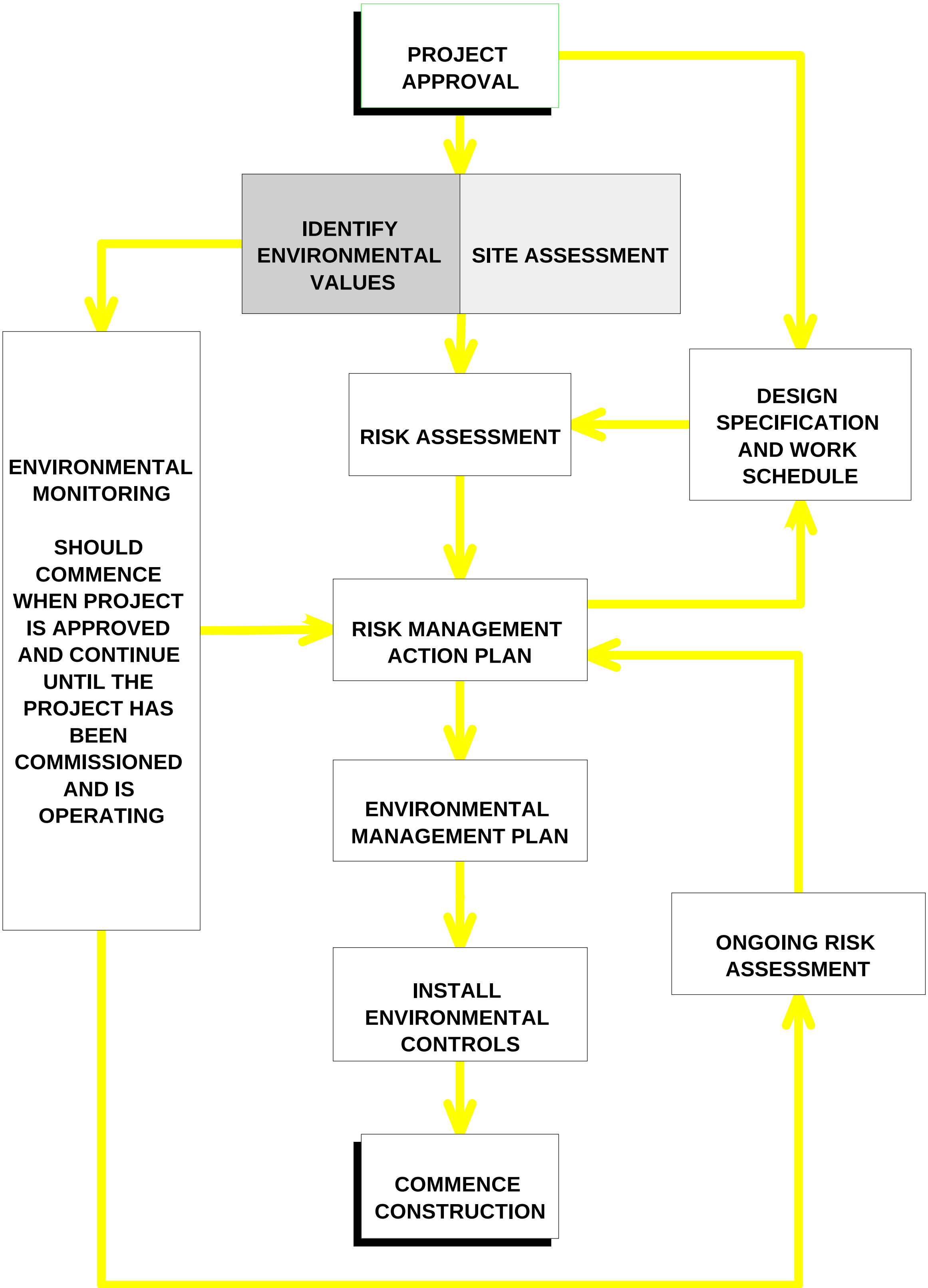
RISK MANAGEMENT

Objective

To implement risk management strategies to reduce all significant risks to the environment to acceptable levels.

Suggested measures

- Develop an action plan to manage all significant risks to the environment.
- Implement, wherever possible, risk management measures at the planning stage of the construction project.
- Select risk management options, in order of preference, based on avoiding risk, reducing risk and controlling risk.
- Identify major control structures, like sediment basins, stormwater diversion drainage and artificial wetlands, and install them before other construction activities commence.
- Install controls as close to the source of the problem as possible.



The relationship between risk assessment, the risk management action plan, the environmental management plan and monitoring

3 ENVIRONMENTAL MANAGEMENT PLAN

3.1 Environmental management plan

The environmental management plan contains all aspects of a project's environmental management, and should be prepared by the contractor before work commences on any construction project.

Once the environmental site and risk assessments, and risk management steps have been completed (see section 2), then implementation of risk management measures is achieved via the environmental management plan.

A pre-requisite for the environmental management plan is for the constructing company to have an environmental management system in place. The environmental management system establishes quality systems to ensure consistently high environment outcomes for the project as a whole. British Standard 7750[2], which has gained wide international acceptance, or the soon to be adopted ISO 14000 series[3] should be used.

3.2 Best practice documents

The environmental management plan should contain best practice source documents which can be used to address significant environmental risks. These are generic, and should be applied to site conditions via the segment environmental control plan.

Sections 4 to 9 present some general principles upon which best practice can be based.

[2] British Standard Institute, Specification for environmental management systems, BS 7750, 1992.

[3] International Standards Organisation, *Environmental management systems*, Draft International Standard ISO/DIS 14001 and 14004.

3.3 Segment environmental control plan

On large sites, it is normal to divide the area into segments. A control plan should be prepared for each segment. Segment boundaries are selected on the basis of natural features, the placement of sub-catchments, or association with different contractors.

A number of elements of the plan will be the same for each segment, such as hours of operation and controls on noise and emissions from vehicles. However, each segment may require area-specific controls.

The controls are taken from the action plan arising out of the risk management process (see section 2.3).

The main components of a segment environmental control plan are as follows:

Work scheduling

Actions taken to reduce or avoid environmental impact by rescheduling works, or prohibiting or limiting certain activities from times of the year when unfavourable climatic conditions exist, should be stated.

Land disturbance

Map the existing topography and changes to the landform of each segment, as construction progresses.

The map should identify critical areas for protection which may be easily erodible, such as highly erodible soils, steep slopes, haul roads, or bare areas.

Stormwater management

It is important to have accurate information about on-site drainage for each micro-catchment so that control devices are adequately designed for the expected flow and load. Such information should be available for each change in landform that affects a micro-catchment.

Specifications for diversion drains and temporary stormwater controls to reduce on-site volumes should be included in the plan.

Control installations and measures

The plan should identify the position and design specification of structures and measures taken to control:

- sediment run-off
- dirt on roads
- noise and vibration
- dust

A schedule for installation of these controls should be included in the plan.

Soil stockpiles and batters

The plan should address how stockpiles and batters are to be managed.

It should include the location of all stockpiles, the interval before they are used, how they are to be stabilised, and what control measures are to be implemented while they are being stabilised.

For permanent batters and temporary or final slopes that have been cut during construction, the plan should indicate how these are to be stabilised and what control measures are to be implemented while stabilisation takes place.

Special operational precautions

When work is being done near an environmentally sensitive area, then special precautions should be identified in the plan

Contingency plans

Site-specific contingency plans are required for significant risks that have not been controlled. For example, the plan should include procedures for managing stormwater from intense storm events or repairing a control structure should it fail.

Rehabilitation

A rehabilitation plan should be developed as soon as possible after the design is finalised.

A schedule for stabilising and revegetating cleared areas should be given, and an ongoing program to maintain rehabilitated areas should also be included.

The site should be rehabilitated so that the impact on the environment is minimal.

Maintenance, inspections and surveillance

A maintenance and inspection program should be provided for all control structures and measures. Ongoing surveillance of the site is required to ensure that new risks are identified as they arise. This allows the environmental management plan to be adjusted to ensure that any new risks are adequately managed.

Ongoing risk assessment and management

Construction sites are continuously changing. It is therefore important that the initial risk assessment (see section 2.2) is updated for each segment. This needs to be integrated into the inspection program.

Updating the plan

The plan should be updated to address deficiencies identified by the monitoring or audit program and as new risks are identified through surveillance.

ENVIRONMENTAL MANAGEMENT PLAN

Objective

To develop an environmental management plan to reduce the adverse impact of construction activities on the environment.

Suggested measures

- A environmental management system should be in place, as a pre-requisite to preparing an environmental management plan.
- Prepare an environmental control plan for defined segments of the site for large sites, or a whole-of-site plan for smaller sites.
- The plan should implement the risk management action plan, include detailed specifications on site-specific controls and include a rehabilitation program in the plan.
- Base the measures in the plan on best practice.
- Update the plan to meet new risks or where inspections, monitoring or audit reveal that measures are ineffective.
- Update the plan to achieve ongoing improvement.

4 LAND DISTURBANCE

Large projects usually involve extensive land disturbance, involving removing vegetation and reshaping topography. Such activities make the soil vulnerable to erosion. Soil removed by erosion may become airborne and create a dust problem or be carried by water into natural waterways and pollute them.

Measures to address the impact of land disturbance on the environment should be included in the planning and design phase of the project, before any land is cleared.

These measures should be placed into the framework of the segment environment control plan (see section 3.3).

4.1 Erosion

When considering land disturbance and its consequences, priority should be given to preventative rather than treatment measures.

To develop effective erosion controls it is necessary to obtain information on the erosion potential of the site where soil disturbance is planned. Erosion potential is determined by the erodibility of the soil (type and structure), vegetative cover, topography, climate (rainfall and wind), and the nature of land-clearing. Erosion potential will also be affected by the type, nature and intensity of earthwork.

Erosion potential of rainfall can be calculated using the universal soil loss equation[4,5]. Conversion to SI metric units is given by Foster et al. (1981)[6]. The erosion potential of wind can also be calculated, and details are available in a paper by Israelsen et al. (1980)[7].

Information on predicted soil losses from land disturbance should be used to plan and engineer control solutions.

Ground cover provides the most effective means of preventing erosion. Consequently, sediment run-off and dust controls depend on retaining existing vegetation or revegetating and mulching disturbed areas as soon as possible.

The following measures should be taken to minimise erosion:

- Keep land clearance to a minimum.
- Avoid wherever possible clearing areas of highly erodible soils and steep slopes which are prone to water and wind erosion.
- Revegetate and mulch progressively as each section of works is completed. The interval between clearing and revegetation should be kept to an absolute minimum.
- Coordinate work schedules, if more than one contractor is working on a site, so that there are no delays in construction activities resulting in disturbed land remaining unstabilised.

---

4 C. E. Israelsen, C. G. Clyde, J. E. Fletcher, E. K. Israelsen, F. W. Haws, P. E. Packer & E. E. Farmer, *Erosion Control during Highway Construction: Manual on Principles and Practices,* National Cooperative Highway Research Program Report 221, Transportation Research Board 1980.

5 R. J. Garvin, M. R. Knight & T. J. Richmond, *Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria*, TC-13, 1979.

6 G. R. Foster, D. K. McCool, K. G. Rendard & W. C. Moldenhauer, C*onversion of the Universal Soil Loss Equation to SI Metric Units*, J. of Soil and Water Conservation, p. 355-359 1981.

7 Israelsen et al. op. cit.

- Program construction activities so that the area of exposed soil is minimised during times of the year when the potential for erosion is high, for example during summer when intense rainstorms are common.

- Stabilise the site and install and maintain erosion controls so that they remain effective during any pause in construction. This is particularly important if a project stops during the wetter months.

- Keep vehicles to well-defined haul roads.

- Keep haul roads off sloping terrain wherever practical.

- Designed the slope of a cut to minimise the angle of incline.

- Cultivating the cut surface will increase infiltration of rainfall and decrease the velocity of water across the slope during rain and therefore reduce erosion.

MINIMISING EROSION

Objective

To minimise the quantity of soil lost during construction due to land-clearing.

Suggested measures

- Schedule measures to avoid and reduce erosion by phasing the work program to minimise land disturbance in the planning and design stage.

- Keep the areas of land cleared to a minimum, and the period of time areas remain cleared to a minimum

- Base control measures to manage erosion on the vulnerability of cleared land to soil loss, paying particular attention to protecting slopes.

- Mulch, roughen and seed cleared slopes and stockpiles where no works are planned for more than 28 days, with sterile grasses.

- Keep vehicles to well-defined haul roads.

- Rehabilitate cleared areas promptly.

4.2 Management of contaminated stormwater

Soil eroded during land disturbance can wash away and contaminate stormwater.

If contaminated stormwater enters a drainage line or stormwater drainage system, it will eventually discharge into an adjacent waterway and pollute it.

The type of sediment controls suitable for a particular situation depend on the nature of the site, in terms of such factors as rainfall patterns, soil type and topography. These factors need to be taken into account when selecting appropriate controls and ensuring that designs are adequate.

There are a number of ways of minimising sediment run-off.

Reduce stormwater on the site

If uncontaminated water enters part of the site that has been cleared, it will quickly pick up sediment and need to be treated. Additional water may also add to the erosion potential, increasing the risk of pollution.

It is therefore desirable to divert clean stormwater away from those parts of the site where soil is to be exposed. This can be done by constructing diversion banks and intercept drains around the site while ensuring that the water discharging from such banks or drains is disposed of without causing erosion.

Wherever possible, the new stormwater drainage system should be installed before any land disturbance activities commence. If possible on-site inlets should not be connected until the site has been stabilised and rehabilitated. In this way, silt-laden stormwater cannot escape the site via this route and pollute surface waters. It will have to be treated on-site.

Water velocities

There is a direct relationship between the velocity of water flowing over exposed soil and the rate of erosion.

Installation of rock structures on the site to retard water flows is an effective measure to reduce erosion in areas where high water flows are expected.

It is desirable to minimise continuous slopes where flowing water can scour.

To prevent scouring, drainage lines may need to be lined or velocity-reducing structures, such as crushed rock or geotextile placed in the drainage line.

Slopes

Any natural drainage lines that discharge water on to the top of a slope should be directed to grassed areas by intercept drains. Otherwise water will run down the slope, eroding it. Perimeter banks or sediment fences should also be constructed at the toe of the slope to contain sediment run-off.

STORMWATER MANAGEMENT

Objective

To minimise the generation of contaminated stormwater.

Suggested measures

- Minimise the quantity of uncontaminated stormwater entering cleared areas.
- Establish cut-off or intercept drains to redirect stormwater away from cleared areas and slopes to stable (vegetated) areas or effective treatment installations.
- Reduce water velocities.

4.3 Designing erosion and sediment control devices

There are a large number of control devices that will suit most circumstances. These *Guidelines* are restricted to addressing the general principles behind erosion and sediment controls rather than providing detailed design specifications.

Most damage is done in the initial part of a storm, between 30 minutes and two hours into a storm, and during prolonged storms.

Designs of control structures, therefore, need to account for peak run-off flows.

Where it is not possible to schedule works to avoid times of the year when high rainfall is expected, then additional controls may be required, such as installing extra sediment traps or enhancing the capacity of existing controls.

Sediment interception and settling

Sediment detention dams, ponds or basins hold sediment-contaminated run-off long enough for suspended sediment to settle out. Clarified water can then be discharged to stream.

Permanent structures that will provide ongoing sediment control, after a site has been rehabilitated, should be designed using a 50-year-recurrence interval. Examples of permanent structures are wetlands and major sediment detention dams.

Temporary sediment control structures should be designed to take predicted flows, based on a one-in-two-year storm (two-year ARI with intensity for six hours) and sub-catchment areas, while contingency plans should be in place to account for extreme storm events. Use the Universal Soil Loss Equation[8] to estimate long-term average annual yield of sediment from small uniform sections of catchments. Run-off and sediment control structures should be designed and constructed to accept the expected peak flows and sediment loads.

Interception and chemical treatment

Fine colloidal clays suspended in run-off require a long time to settle, often exceeding the economic or practical detention storage capacity. Flocculants may need to be added to hasten settlement.

Residual flocculant in suspension should not be released if it degrades water quality or the aquatic habitat in natural waterways. Chemical sludge will require off-site disposal to a landfill licensed to accept such wastes.

Sediment filtering

Adequate controls should be placed on all drainage lines. Silt loads should be treated as close to their source as possible using effective sediment traps such as geotextile fences and straw bales.

In-stream controls

When the site is intersected by a stream, then in-stream controls such as a rock weir are required to reduce water velocity and trap sediment. Special precautions should be taken when cleaning behind a weir to ensure that trapped sediment is not resuspended.

Inspection, maintenance and cleaning

The effectiveness of sediment control devices depends on an adequate inspection, maintenance and cleaning program. Inspections, particularly during storms, will show whether devices are operating effectively (see section 9.1). Where a device proves inadequate, it should be quickly redesigned to make it effective.

---

[8] C. E. Israelsen et al. op. cit.

SEDIMENT CONTROLS

Objective

To minimise the impact of contaminated stormwater on receiving waters.

Suggested Measures

- Install erosion and sediment control measures, if possible before construction commences.
- Identify drainage lines and install control measures to handle predicted stormwater and sediment loads generated in the mini-catchment.
- Design and install appropriate erosion and sediment run-off control measures appropriate to site conditions to handle a one-in-two-year storm event (two-year ARI with intensity of six hours), for temporary structures, and a one-in-fifty year storm event, for permanent structures.
- Establish an adequate inspection, maintenance and cleaning program for sediment run-off control structures.
- Ensure that contingency plans are in place for unusual storm events.
- Continually assess the effectiveness of sediment control measures and make necessary improvements.

There are a large number of erosion and sediment run-off control devices which are available. The selection and design will depend on site-specific considerations and it is beyond the scope of these to outline how to design such installations. Further information should be obtained directly from the references, which are listed below:

Auckland Regional Water Board, *Urban Earthworks - A Guide for Erosion*, Technical Publication no. 7, 1979.

Aveyard J M (ed.), *Design Manual for Soil Conservation Works*, Soil Conservation Service Technical Handbook no. 5, NSW Department of Soil Conservation and Land Management, 1982.

Department of Conservation and Land Management, *Urban Erosion and Sediment Control*, NSW, 1992.

NSW Department of Housing, *Soil and Water Management for Urban Development*, NSW, 1993.

Environment Protection Authority, *Construction Techniques for Sediment Pollution Control*, Publication no. 275, 1991.

Garvin, R. J., Knight M. R. & Richmond T. J., *Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria*, TC-13, 1979.

Goldman, S. J., Jackson, K. & Bursztynsky, T. A., *Erosion and Sediment Control Handbook*, McGraw-Hill Book Company, 1986.

Highway Research Board, *Erosion Control on Highway Construction*, National Cooperative Highway Research Program, Synthesis of Highway Practice 18, 1973.

Pollution Control Authority, *Guidelines for Erosion and Sediment Control on Building Sites*, ACT, 1989.

Quilty, J. A., Hunt, J. S. & Hicks, R. W., *Urban Erosion and Sediment Control*, Soil Conservation Service Technical Handbook, no. 2, Soil Conservation Service of NSW, 1978.

Ransom M. J., *Control of Erosion on Construction Sites*, Department of Conservation, 1987.

Richards, D. L. & Middleton, L. M., *Best Management Practices for Erosion and Sediment Control*, Department of Transportation, 1978.

Rosewell, C.J. & Edwards, K., *SOILOSS - A Program to Assist in the Selection of Management Practices to Reduce Erosion*, Soil Conservation Service Technical Handbook, no. 11, NSW Department of Conservation and Land Management, 1988.

Scott & Furphy Pty Ltd, *Design Manual for Urban Erosion and Sediment Control*, National Capital Development Commission, 1988.

Water Resources Administration, *Maryland Standards and Specifications*, Maryland Department of the Environment, 1994.

4.4 De-watering work sites

After rain, pooled water is often pumped off-site. Often this water is contaminated with suspended sediment so it is essential that its disposal should not contribute to water pollution.

To remove water from the work area, the pump intake should be kept as close to the surface of pool as possible. Floating intakes should be used when the depth of water is sufficient. Care must be taken to avoid pumping from the bottom of ponds, and constant supervision is required during pumping operations to ensure this does not happen.

Treatment is required before discharging run-off to a natural waterway or stormwater system, where turbidity exceeds 30 NTU[9] and is higher than upstream measurements. Hourly measurements of discharge water quality should be taken.

Contaminated water pumped off the site should, wherever possible, be directed to vegetated areas. Precautions should be made to ensure that such areas don't become waterlogged and have adequate capacity to effectively remove suspended solids.

Where vegetated areas are not available, then water should be directed to existing or specially provided sediment control structures.

Pumping to natural waterways should be supervised through the operations.

In urban areas it may be possible to discharge contaminated run-off to sewers. Such a discharge will require approval of the relevant sewerage authority.

This option is of limited usefulness as de-watering the site will usually be required during or immediately after rainfall, when the sewers are also be near capacity and unable to accept any additional volume.

DE-WATERING WORK SITES

Objective

To ensure that de-watering operations do not result in turbid water entering natural waterways.

Suggested measures

- Treat contaminated water pumped into the stormwater system or a natural waterway to remove sediment if the turbidity exceeds 30 NTU.
- Ensure that the level of suspended solids in waters pumped into natural waterways never exceeds the regulatory water quality standard.
- De-water by pumping water, wherever practical, on to vegetated area of sufficient width to remove suspended soil, or to sediment control devices.
- Supervise all pumping and implement precautions to ensure that turbidity of pumped water is minimised.
- Monitor every hour during a pumping operation the turbidity of water pumped directly to a natural waterway or a drainage system discharging to a natural waterway .

---

9 NTU is an abbreviation of nephelometric turbidity units, which is a measure of light scattered as it passes through a solution. It is not directly related to suspended material, but is a good measure of the clarity of a water sample. It can easily be measured in situ, making it a convenient measurement when an on-the-spot decision needs to be made.

4.5 Dust control

Many of the measures taken to reduce dust problems are the same as those taken to minimise erosion and sediment run-off.

Additional measures, not mentioned in the sections on erosion or sediment control, are outlined below.

- Prevent the generation of dust in preference to applying dust suppression measures.
- Ensure in the project schedule that the area of cleared land is minimised during the drier months of the year, when dust generation is at its greatest.
- Pave and water haul roads. The frequency of watering will be determined by weather conditions and the erodibility of the soil. If additives in the water are used to increase its dust suppression properties, the chemical should have no adverse environmental impact on adjacent water bodies.
- Water areas other than haul roads, if they are a source of dust.
- Ensure that smooth surfaces are deep ripped and left rough and cloddy to reduce the wind velocity at the soil surface.
- Construct wind fences if this is appropriate for the site.

As a contingency measure, in areas that do not have access to a reticulated water supply, water stored on-site should never be less than 2,000 litres per hectare of disturbed land surface.

Wherever watering is used to suppress dust, ensure it does not create contaminated run-off that will contaminate surface waters.

DUST CONTROL

Objective

To ensure there is no health risk or loss of amenity due to emission of dust to the environment.

Suggested measures

- Implement a dust prevention strategy, developed at the project planning stage.
- Take dust suppression measures, such as promptly watering exposed areas when visible dust is observed.
- Install wind fences wherever appropriate.

4.6 Management of stockpile and batters

Stockpiles and batters are a potential source of dust and sediment run-off.

Additional controls to those covered previously are outlined below.

- Locate stockpiles away from drainage lines to where they are protected from wind.
- Minimise the number and size of stockpiles.
- Keep topsoil separate from underburden when stockpiling soil.
- Construct the stockpile with no slope greater than 2:1 (horizontal to vertical). A less steep slope may be required where the erosion risk is high.
- Mulch, roughen and seed with sterile grasses any batter or topsoil stockpile which is to be maintained for longer than 28 days.
- Treat underburden stockpiles in the same way, but check whether they need a layer of

topsoil to provide a media for grass seeds before seeding.

- Circle all unstabilised stockpiles and batters with silt fences or a drainage system that will collect and correctly dispose of contaminated water (see section 4.2).

- Locate stockpiles within ten metres of a waterway *only* if no other alternatives exist. This situation should be identified in the risk assessment.

- Hand water or install temporary sprinklers to suppress dust from unstabilised stockpiles and batters.

- Finish and contour any stockpiles located on a floodplain so as to minimise loss of material in a flood or rainfall event.

MANAGEMENT OF STOCKPILES AND BATTERS

Objective

To manage soil stockpiles so that dust and sediment in run-off are minimised.

Suggested measures

- Minimise the number of stockpiles, and the area and the time stockpiles are exposed.

- Keep topsoil and underburden stockpiles separate.

- Locate stockpiles away from drainage lines, at least 10 metres away from natural waterways and where they will be least susceptible to wind erosion.

- Ensure that stockpiles and batters are designed with slopes no greater than 2:1 (horizontal/vertical).

- Stabilise stockpiles and batters that will remain bare for more than 28 days by covering with mulch or anchored fabrics or seeding with sterile grass.

- Establish sediment controls around unstabilised stockpiles and batters.

- Suppress dust on stockpiles and batters, as circumstances demand.

4.7 Working in waterways and floodplains

The responsible drainage body must be consulted if there are any works that will impact on a waterway. Changes to the physical nature of a waterway require prior approval from the responsible drainage authority.

At the design stage, consider all options to avoid working in a natural waterway.

Procedures

Where it is not possible to avoid working in a stream, then additional precautions should be taken.

- Minimise the time during which work in a waterway is required, and the extent of works.
- Schedule works for the driest months of the year and the lowest flow of the waterway.
- Avoid times of the year when aquatic population may be under stress, such as during migration spawning, or when food may be scarce.
- Establish protocols to minimise downstream damage.
- Stabilise any disturbance to a levee or any other bank so that erosion is avoided.
- Measure turbidity continuously immediately downstream from the areas in which work is occurring, and modify work practices where continuous monitoring shows degraded water quality.
- If working in a concrete channel, use appropriate machinery to avoid damage to structures.

Stream crossings

If in-stream activities require construction of a stream crossing, it should be installed during low-water flows with downstream weirs in place to trap any released sediment.

Three types of access crossings may be considered.

- Culvert: this type of crossing may be effective in controlling erosion while in use, but will cause erosion during installation and removal.
- Ford: this type of crossing may only be used during periods of low flow. A ford is not appropriate if construction will continue during wet periods of the year.
- Bridge: this type of crossing must be used for major waterways and for other waterways with high flows.

The crossing should be protected against erosion, both to prevent excessive sedimentation in the waterway, and to prevent washout of the crossing.

The crossing should be positioned perpendicular to the flow and located at the narrowest part of the stream. Damage to the stream bed and banks should be avoided. The crossing should be engineered to be stable under the expected vehicle loads. Drainage over the surface of the crossing and access road should have adequate controls to ensure that sediment run-off to the stream is minimised.

If a cofferdam is used, minimum downstream flows should be maintained that will sustain the aquatic ecology.

Stream crossings also act as sediment traps. Cleaning sediment out behind a crossing should follow the same procedure as for weirs.

Contingency planning

As mentioned in section 4.3, it is best practice to design pollution measures and controls to account for a one-in-two-year storm event (two-year ARI with intensity of six hours).

Contingency plans should also be in place for more intense storm events, particularly where works are planned to occur within a floodplain.

The contingency plan should consider the consequences on the environment of 5, 10, 20 and 100-year-frequency floods.

The contingency plan should address:

- methods to limit stormwater entering excavation areas
- enhancement of existing measures and installation of additional controls, when an intense storm event is forecast
- siting of construction facilities
- clean-up procedures, including disposal of excess water
- a flood warning system
- procedures for preventing the loss of spoil, fuel, chemicals or other materials that could adversely affect the environment
- notification of relevant authorities if unplanned incidents occur that could pose a risk to the environment

Reinstatement plan

Prior to works being undertaken on, near or within a waterway, a reinstatement plan should be prepared and submitted for approval to the responsible drainage authority. The plan should include:

- proposed changes to the waterway
- the impact on adjacent vegetation
- the type and form of flood protection works
- erosion and sediment run-off controls
- proposed methods for reinstatement of the waterway bed and banks
- a revegetation plan addressing a period of no less than 12 months and including proposed species and locations, methods for weed control and ongoing maintenance until a satisfactory level of established plants is achieved.

WORKING IN WATERWAYS AND FLOODPLAINS

Objective

To minimise stress on aquatic communities when working in a waterway.

Suggested measures

- Plan in-stream works so that the contact time is minimised.
- Establish special practices so that impacts on the waterway and disturbance of its banks are minimised.
- Stabilise banks and in stream structure so that they do not contribute to the sediment load.
- Maintain minimum flows to ensure the viability of aquatic communities and ensure that there are no barriers to the passage of fish up and downstream.
- Avoid times of the year when environmental damage is expected to be highest.
- Construct in-stream crossings during low flows, designed to be stable under expected vehicle loads and flow regimes, that do not contribute to the sediment load in the stream.
- Design crossings so that drainage off the crossing does not contribute sediment load to the stream.
- Prepare a contingency plan for high-rain events.
- Prepare a reinstatement plan if work in a stream is planned or the structure of a waterway will be altered.

5 NOISE AND VIBRATION

While no specific statutory controls exist for noise from construction sites, all noise nuisance should be reduced wherever possible from vehicles, fixed machinery within the site, blasting, general construction activities, and from movements of vehicles servicing the site.

5.1 Operating hours

One of the most effective means of reducing noise nuisance from construction activities, where there are residents nearby, is to limit the times of operation of noisy equipment vehicles, and operations.

There are occasions when it is necessary to work beyond these times. Exceptions can be made in cases where an activity that has commenced cannot be stopped, such as a concrete pour, and deliveries may need to be made outside normal working hours to avoid a major traffic hazard.

Documentation justifying out-of-hours work should be maintained and authorised by site management. Local residents who are affected by such activities should be notified beforehand.

Even with such restricted hours, every effort should be made to reduce the noise of all site activities.

5.2 Vehicles and equipment

Noise from vehicles and powered machinery and equipment on-site should not exceed the manufacturer's specifications, based on the installation of a silencer. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipment.

5.3 Traffic

There is a conflict between operational efficiency and local amenity, with regard to traffic flows in and out of a construction site. During normal business hours when traffic densities are high, deliveries of materials and large equipment can cause severe traffic snarls and even pose a danger to other vehicles. Out-of-hours deliveries will cause noise pollution from trucks moving past nearby houses.

5.4 Noise abatement

Depending on the location of the facility, suitable noise suppression or abatement measures may be required, such as the provision of earthen embankments or other noise screens.

5.5 Vibration

On road constructions, impact pile-driving may be used to establish a base for foundations. These operations can give rise to high levels of ground vibrations.

The magnitude of the nuisance created by vibrations depends on the nature of soils transmitting the vibration and the distance to the nearest building.

A British study[10] has found that nuisance from ground vibration and building damage is unlikely to occur if the operation is conducted at distances greater than 50 metres.

---

10 D. J. Martin, *Ground Vibrations from Impact Driving during Road Construction,* Supplementary Report 544, Transport and Road Research Laboratory, 1980.

Complaints about air vibrations from blasting have been received from people 100 metres away from the activity.

NOISE AND VIBRATION

Objective

To ensure nuisance from noise and vibration does not occur.

Suggested measures

- Fit and maintain appropriate mufflers on earth-moving and other vehicles on the site.
- Enclose noisy equipment.
- Provide noise attenuation screens, where appropriate.
- Where an activity is likely to cause a noise nuisance to nearby residents, restrict operating hours to between 7 am and 6 pm weekdays and 7 am to 1 pm Saturday, except where, for practical reasons, the activity is unavoidable.
- Noise should not be above background levels inside any adjacent residence between 10 pm and 7 am.
- Advise local residents when unavoidable out-of-hours work will occur.
- Schedule deliveries to the site so that disruption to local amenity and traffic are minimised.
- Conduct a study on the impact of ground vibration from construction activities, where these operations occur within 50 metres of a building and take appropriate action.
- Minimise air vibrations.

6 WASTE MINIMISATION

When choosing between waste minimisation options, the following hierarchy for waste management is preferred:

(i) waste avoidance and/or reduction

(ii) reuse

(iii) recycling

Diverting the waste stream in these ways means that waste treatment and waste disposal options can be reduced.

Construction sites should pursue this hierarchy and seek out waste reduction opportunities.

To identify opportunities it is necessary to consider all aspects of the project and the wastes it generates.

Waste can be minimised by using improved technology, recycled or reused on-site, or by making purchasing decisions that favour recycled products.

Wherever possible, include performance measures and targets for reduction, reuse and recycling options in the environmental management plan.

Waste minimisation opportunities include:

- obtaining construction materials, paints, lubricants and other liquids in reusable packaging or containers
- using noise barriers made from recycled materials
- using overburden to construct temporary noise barriers.
- using contaminated water out of sediment dams for dust suppression and irrigating adjacent vegetated land
- sending waste concrete from demolition activities to a concrete recycler instead of landfill
- segregating and recycling solid wastes generated by construction activities, offices and mess-rooms
- collecting lubricating oil from the construction vehicle fleet and sending it to a recycler

WASTE MINIMISATION

Objective

To minimise the waste load discharged to the environment.

Suggested measures

- Carry out a waste minimisation assessment which examines opportunities for waste avoidance reduction, reuse and recycling.
- Reduce wastes by selecting, in order of preference, avoidance, reduction, reuse and recycling.
- Incorporate waste minimisation targets and measures into the environmental management plan.

7 CONTAMINATED MATERIAL AND WASTES

On large construction sites, it is possible that old tips will be uncovered or the land found to be contaminated. Where this occurs contaminated material or soil may need to be disposed of.

Disposal methods adopted depend on the nature of the material. To obtain this information, a comprehensive sampling and analysis program is required so that the correct route for disposal can be determined. For an old tip, sampling should also ascertain the odour levels, presence of methane, groundwater levels and leachate quality.

7.1 Solid inert wastes

Solid inert waste found on construction sites usually consists of building rubble, but may also include as demolition material, concrete, bricks, timber, plastic, glass, metals, bitumen, trees and shredded tyres. Such wastes should be reused, recycled, or disposed of to a landfill site licensed to take such wastes.

7.2 Putrescible wastes

Old tips that accepted municipal rubbish also contain putrescible wastes.

Putrescible wastes are defined as waste able to be decomposed by bacterial action. It usually consists of discarded food, domestic garbage, commercial wastes, grass and garden clippings and prunnings.

As many old tips were not licensed by EPA it is possible that other wastes were buried, and the inspection and analytical program should be designed to detect other materials if they are present.

Old tips may also contain contaminated leachate and gases, such as methane and odorous sulphur gases.

The biological and chemical condition of the tip will depend on its age and contents.

Excavating putrescible wastes could give rise to the following problems:

- escape of methane and odorous landfill gases
- release of contaminated leachate
- production of litter
- prevalence of seagulls and vermin

Precautions will need to be taken during excavation to ensure that these problems are adequately controlled.

The controls for the excavation, disposal and rehabilitation of the remainder of the tip are outlined below:

- Contain, extract and treat or dispose of contaminated water to the sewerage system, provided the appropriate approvals from the appropriate water board have been obtained.
- Extract and flare landfill gases, if sufficient quantities are present.
- Control odours during excavation by minimising the working surface area and immediately covering with a clean fill. A deodoriser might also be needed to minimise emissions of malodorous gases to the atmosphere.
- Limit leachate generation by minimising infiltration or ingress of water into the landfill through installation of cut-off drains, banks or bunds around the excavation areas.

- Cap excavated areas with an impermeable material (0.5 metre minimum).

Transport of the excavated putrescible waste to a licensed landfill may also cause problems. Old putrescible wastes can be highly odorous, and additional measures may need to be taken, such as using sealed and covered containers.

7.3 Low-level contaminated soil

Old tips may contain soil contaminated with chemicals such as heavy metals and hydrocarbons. Construction sites may also intersect contaminated sites, with elevated levels of heavy metals, hydrocarbons or other toxic chemicals.

The classification of contaminated soil depends on the concentrations of the contaminants and their leachability, as described in an EPA information bulletin[11].

The bulletin describes levels of contaminants (Table 1) which define clean fill, and can therefore be disposed of without restriction.

The bulletin also describes levels of pollutants (Table 2) which define heavily contaminated soil. Disposal of prescribed wastes and heavily contaminated soil is discussed in section 7.4.

However, if contaminant concentrations and leachabilities are between the limits in Tables 1 and 2, the soil is classified as low-level contaminated and should be disposed of at an appropriately licensed landfill, with a letter of approval from EPA.

7.4 Prescribed wastes

If on-site materials that have to be excavated are prescribed waste, as defined by the *Environment Protection (Prescribed Waste) Regulations* 1987, it will need to be transported in accordance with the *Environment Protection (Transport) Regulations* 1987 to a landfill licensed to accept such wastes.

It should be noted that care should be taken handling prescribed wastes, so that they do not pose a health risk to workers.

CONTAMINATED MATERIAL AND WASTES

Objective

To ensure that all contaminated material uncovered on a construction site are excavated and disposed of in an environmentally responsible manner.

Suggested measures

- Assay material uncovered on-site prior to disposal. If the wastes include putrescible wastes, then also analyse leachate and landfill gases.
- Excavate material in a manner which avoids off-site environmental problems.
- Seal remaining contaminated material or wastes, where only part of the tip has been excavated, to ensure that there is no off-site effect now or in the future.
- Transport odorous wastes in covered vehicles.
- Dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

---

[11] Environment Protection Authority, *Classification of Wastes*, Publication 448, 1995.

8 OTHER ENVIRONMENTAL ISSUES

8.1 Emergency procedures

Procedures should be in place, and staff trained to deal with any emergency, which could cause major environmental damage.

Adequate equipment, such as spill kits, should be kept on-site to deal with emergency spills.

The EPA should be contacted immediately an emergency occurs on (03) 9628 5777.

8.2 Air Quality

There are three potential sources of air pollution on construction sites. They are exhaust gases from vehicles and machinery and exhaust material from chippers. Dust was addressed in section 4.

AIR QUALITY

Objective

To ensure there is no health risk or loss of amenity due to emission of exhaust gases to the environment.

Suggested measures

- Ensure that all vehicles and machinery are fitted with appropriate emission control equipment, maintained frequently and serviced to the manufacturers' specifications.
- Smoke from internal combustion engines should not be visible for more than ten seconds

8.3 Litter

On construction sites, there are two main sources of litter, building material washed away during a storm and deposited into waterways, and rubbish thrown away by construction workers.

Litter is often caused by thoughtlessness of staff and the unavailability of suitable litter bins on the construction site.

LITTER

Objective

To ensure that all litter is disposed of in a responsible manner, and is not released into the environment.

Suggested measures

- Maintain a high quality of housekeeping and ensure that materials are not left where they can be washed or blown away to become litter.
- Provide bins for construction workers and staff at locations where they consume food.
- Conduct ongoing awareness with staff of the need to avoid littering.

8.4 Storage of chemicals and fuels

Although it may be necessary to store fuels and chemicals on project sites, this inevitably creates an environmental risk. Spills can severely pollute waterways and land.

Reducing the quantities of chemicals and fuel stored on-site to minimum practicable levels is desirable. Infrequently used chemicals should be ordered just before they are needed. It may be possible to use a mini-tanker to refuel vehicles, instead of relying on a central fuelling point.

There are several approaches that can be taken to reduce the risk of fuel spills. Steps could include designing storage units to prevent vehicles or fork-lifts puncturing tanks, fitting automatic cut-offs to fuel dispensers, and making units vandal resistant.

Installing bunds will prevent spilt fuel escaping and causing environmental damage. Bunds should be designed and installed in accordance with EPA guidelines[12].

Key design issues addressed in the guidelines are height of bund walls, construction material, vehicular access, and stormwater management. Roofed bunds are strongly preferred.

Should a spill occur, then it is necessary to have a contingency plan in place to deal with the clean-up. It should consider issues such as cleaning up spilled material on the site, containing and cleaning up spills which have entered waterways, disposal or reuse of recovered residues, and contacting key company and government agency personnel to advise them of the emergency.

12 Environment Protection Authority, *Bunding Guidelines*, Publication 347, 1992.

STORING FUELS AND CHEMICALS

Objective

To ensure that fuel and chemical storage is safe, and that any materials that escape do not cause environmental damage.

Suggested measures

- Minimise fuels and chemicals stored on-site.
- Install bunds and take other precautions to reduce the risk of spills.
- Implement a contingency plan to handle spills, so that environmental damage is avoided.

8.5 Road cleaning

Some sites require vehicles to move on and off the site. It is possible that these vehicles will transport soil off the site and deposit it on the adjacent roads.

Prevention of soil being deposited on roads is preferable to cleaning them afterwards.

All points on the site where vehicles regularly leave should have rumble grids and wheel washes installed. In wet weather it may be necessary to hose mud off vehicle wheels as they traverse the grid.

All exits leading to the above mentioned controls should be paved with gravel. Top dress these paths periodically , and remove sediment from the wheel wash.

Where there is only occasional use of road crossings (twice a day or less), or where there is insufficient space on the site to install a rumble grid and wheel wash then (at least) daily road sweeping should be instituted. Care should be taken to ensure that road sweeping does not give rise to dust problems.

The number of times a day that road cleaning occurs should be determined by the frequency of road usage and the state of the roads, which should be inspected often.

Installation of litter traps lined with filter cloth in side-entry pits will trap soil in stormwater spilt on roads during rain.

Where soil is being transported for off site disposal, then all loads should be covered.

KEEPING ROADS CLEAN

Objective

To ensure that roads are kept clean of soil.

Suggested measures

- Install wheel washes and rumble grids at all main road crossings.
- Ensure that the roads are swept at least once a day on uncontrolled road crossings when construction vehicles are travelling off the site.
- Install litter traps lined with filter cloth in all side-entry pits .
- Cover all loads of soil being taken off site for disposal.

8.6 Protecting infrastructure

In built-up areas, care needs to be taken in working near existing infrastructure services such as drainage and sewerage pipes.

It is important to ensure that any existing drainage or sewerage pipes that intersect the construction site or are adjacent to it are not overstressed or damaged by movement or placement of construction plant or materials, or construction activities.

Appropriate machinery must be used within concrete channels to avoid damage to structures.

8.7 Concrete batching plants

Sometimes very large construction projects will establish on-site concrete batching plants.

Plants need to be designed in accordance with EPA guidelines[13].

Constructing a plant which is designed to have a throughput of greater than 100 tonnes per week will need an EPA works approval.

---

13 Environment Protection Authority *Concrete Batching Plants* Publication TG 204/91, 1991.

9 INSPECTIONS, MONITORING AND AUDITS

9.1 Inspections

The frequency of inspections depends on the risks posed to the environment by each construction activity or the nature of the site . These recommendations should be taken as minimum frequencies. The frequency of inspections, monitoring and auditing recommended below is based on experience of large freeway construction.

Installation	Possible problems	Frequency	Remedial action
Drainage	New drainage lines not controlled	At least once every two days in areas where earth-moving is occurring Weekly elsewhere	Install appropriate sediment controls on new drainage lines
Sediment controls, silt fences and traps	Not controlled effectively	Daily in dry weather Within first two hours of a storm[#] Three times a day during prolonged rainfall[#]	Remove sediment from trap Replace barrier or filter material Redesign installation Improve maintenance
Haul roads	Dust Soil on paved roads	At least daily	Pave haul roads with gravel or impervious sealant Install wheel wash and rumble grid Manually wash vehicle wheels Increase road cleaning frequency
Cut-off and diversion drains	Water not diverted away from sensitive areas	Weekly	Replace or repair damaged drains Redesign ineffective drains Relocate incorrectly placed drains

[#] See also table on monitoring requirements under the same heading.

Installation	Possible problems	Frequency	Remedial action
In-stream weirs	Ineffective during low flow	Weekly in dry weather	Educate sediment trapped behind weir
	Release of trapped sediment during storms	24 hours before forecast rain	Clean out behind weir if filled to 25% capacity
Stream crossings	Unstable Releasing sediment and soil into stream	When in use, but no less than weekly	Stop use until installation has been redesigned
Vegetated buffer zones	Accidentally cleared	Weekly	Revegetate Review procedures to ensure no recurrence
Retardation and settlement basins and artificial wetlands	Sediments not effectively removed	Weekly	Redesign installation Increase retention times Add flocculants*
Stockpiles and bare slopes	Erosion	Weekly	Minimise exposure to run-off and action of wind Ensure stabilisation measures are effective
Unvegetated areas	Dust	Daily during dry weather	Increase use of water spray on unvegetated areas Protect untrafficked areas temporarily with mulch or geo-fabric blanket
Vehicles and machinery	Noise pollution Exhaust gases	Initially when vehicle or machinery is introduced to the site and thereafter monthly	Ensure that mufflers and noise-shielding are effective Ensure that emission controls are effective and motors well maintained

* This option should be avoided wherever possible because it creates a problem with sludge removal.

Installation	Possible problems	Frequency	Remedial action
Chemical storage areas	Spills	Weekly	Clean-up contaminated area Improve bunding
Litter controls	Litter on and off-site	Daily on and off-site	Clean-up litter originating on-site Review number and placement of rubbish bins Ensure materials are not stored in such a manner that they could contribute to litter Speak to staff about the litter disposal

9.2 Monitoring

Regular monitoring of air and water and taking of noise measurements is required to determine whether standards, established by the Environmental Management Plan, are being complied with. This should commence before construction to provide a baseline against which data collected during construction can be compared.

Chemical measurements should be conducted by a laboratory registered by the National Association of Testing Authorities (NATA), and in situ measurements should be made under the supervision of a suitably qualified person from a NATA laboratory.

Monitoring should provide information on whether standards are being complied with and sensitive sections of the environment protected. The following recommendations should be treated as minimum monitoring requirements relating only to the direct impact of construction activities. Other monitoring programs may be required for major road projects to determine their future impact on traffic emissions.

Area of risk	Purpose	Monitoring activity	Remedial action
Noise	Determine whether a noise nuisance exists	As required by complainants at their homes	Review and enhance noise control measures
		Monitor noise continuously at a representative residence near construction activities	
Air quality (dust)	Determine whether a dust nuisance exists	Daily during dry weather for dust deposits at locations that indicate impact on adjacent residents or at site boundary	Improve controls on dust emissions

Area of risk	Purpose	Monitoring activity	Remedial action
Water quality (chemical and biological)	Quantify downstream chemical and biological impact Identify ineffective sediment control installations	Design chemical and biological monitoring program by regularly surveying upstream and downstream sites, in consultation with water resource manager, to assess impact on stream ecology under all flow conditions Install continuous monitors for turbidity* and flow	Revise on-site controls if regulatory standards are breached Revise risk assessment and management Identify and repair failed control installation
Sediment controls, silt fences and traps	Determine whether the installation is operating effectively	Measure turbidity on the input and output side of control devices during wet weather inspections (see inspection table in section 9.1)	Redesign control devices
Discharge from retention ponds, artificial wetlands and sediment dams	Determine whether retention structures are effectively removing sediment	Weekly for suspended solids, conductivity, pH and dissolved oxygen, and daily during rainfall	Redesign retention structures
River crossings	Determine whether crossings are stable	Measure turbidity up and down stream from the crossing when in use (see inspection table in section 9.1)	Stabilise structure
Pumping contaminated water to the stormwater system or natural waterway	Ensure that natural waters are not adversely affected by pump-out water	Measure turbidity every hour during pumping	Stop pumping if turbidity exceeds regulatory standards

* Continuous turbidity monitors should be installed where work is being done in a natural waterway or immediately adjacent (within 30 metres) of a waterway.

Area of risk	Purpose	Monitoring activity	Remedial action
Excavated material	Detect old fill material that may contain contaminated soil or rubble	Daily in areas being excavated	Analyse fill material suspected of being contaminated Remove contaminated material to a landfill licensed to accept the wastes (see section 7) and ensure that necessary approvals have been obtained

5.3 Auditing

Independent audits should be conducted on environmental performance and systems by experts in construction activities and environmental management. Different people can be used for each type of audit.

INSPECTIONS, MONITORING AND AUDITING

Objective

Conduct checks on significant environmental risks to ensure that they are adequately managed and control systems are operating effectively.

Suggested measures

- Establish a baseline monitoring program before construction commences.
- Prepare an inspection, monitoring and auditing program, designed to match the environmental risks.
- Ensure that remedial action is taken promptly when monitoring,, inspections or audit results reveal a problem in environment management.
- Ensure that all monitoring is conducted by a NATA registered laboratory, either directly, or under supervision.
- Arrange for regular independent audits of environmental performance and the environmental management system.

APPENDIX 1 CHECKLIST

This Checklist summarises the specific environmental issues that need to be addressed on construction sites. Provision is made in the list for the manager to check off each issue as it relates to the site. The issues are listed in the same order as they appear in the *Guidelines.*

Issue	Action taken	Section
Compliance with legislative requirements	Collect copies of all relevant legislation, regulations and government policy.	1
	Ensure management is aware of their requirements and implements due diligence systems to ensure compliance.	1
	Use documents collected to set minimium standards in the environmental management plan.	1
Pre-construction planning		
Environmental assessment	Assess all possible impacts that the project will have on the environment.	2.1
	Determine whether construction activities will intersect a contaminated site or old tip.	2.1
	Assess impact of the development on the amenity of adjacent residents.	2.1
	Commence monitoring all segments of the environment to determine background conditions.	2.1
Risk assessment information	Collect all relevant information on the site, and adjacent areas, that may be affected by the development.	2.2
	Collect relevant weather and climate information.	2.2
	Obtain design plans, work schedules and work programs that may contribute to environmental risk.	2.2
	Obtain map of site topography and generate maps of changes in topography, as a result of the development.	2.2
	Calculate stormwater flows in each micro-catchment for each phase of the development.	2.2
	Map changes of vegetative cover and the position of stockpiles and batters, as a function of time.	2.2
	Collect information on stream flows of any natural waterways that will be affected by the development.	2.2
Assessing and managing risks	Identify all hazards to the environment.	2.2

	Quantify hazards, whever possible.	2.2
	Determine consequences of each hazard.	2.2
	Calculate total risk level for each hazard.	2.2
	Rank risks.	2.2
	Identify all significant risks.	2.3
	Develop an action plan to address all significant risks.	2.3
	Wherever possible seek to avoid risks or minimise them by modifying the project design or planned work program and schedule.	2.3
	Based on information of monitoring, inspection and surveillance, update risk assessment, management and the environmental management plan.	3.3
Pre-construction works	Install stormwater drainage system (particularly to divert stormwater around the site) and major sediment controls prior to the project's commencement.	2.3
Environmental management plan	Construction company must have an environmental management system in place before preparing the environmental management plan for the project.	3.1
Environmental management system	Ensure that all staff are adequately trained.	3.1
	Ensure that all procedures are written down.	3.1
	Ensure that control and quality assurance systems are in place to ensure effectiveness of the environmental management system.	3.1
	Prepare an environment management plan based on the risk management action plan.	3.1
Prepare plan	List special work procedures to avoid or reduce environmental harm.	3.2
	Map cleared areas, as a function of time.	3.2
	Map changes of landform as a function of time and identify control measures on the map and position of soil stockpiles and batters.	3.2
	Include any special operational procedures required to protect the environment in the work site manual.	3.2
	Ensure that written contingency plans have been prepared and adequately resourced.	3.2
	Ensure that best pactice documents for the site are prepared and implemented.	3.2
	Document maintenance, inspection and surveillance schedule.	3.2

	Prepare a rehabilitation plan.	3.2
	Update plan, as required.	3.2
Land disturbance		
Erosion	Characterise erosion potential of the site during each phase of the development.	4.1
	Take action to minimise clearance of vegetation.	4.1
	Implement controls and re-schedule works to reduce erosion.	4.1
	Stabilise cleared areas as soon as possible.	4.1
	Avoid working on areas vulnerable to erosion, wherever possible.	4.1
Stormwater management	Reduce quantity of contaminated stormwater entering project site.	4.2
	Reduce water velocities, wherever possible.	4.2
	Reduce stormwater flows over bare slopes.	4.2
Erosion and sediment control devices	Design control devices to handle expected peak water flows.	4.3
	Treat intercepted water, if required, priorito discharge to the environment.	4.3
	Install control devices, as required.	4.3
	Install in-stream weirs, as required.	4.3
	Implement a maintenance and inspection schedule for control devices.	4.3, 9.1, 9.2
	Prepare contingency plan and ensure it is adequately resourced.	4.3
	Improve design of control measures, if they don't operate effectively.	4.3
De-watering work site	Establish procedures to ensure that contminated water is not pumped into a natural waterway without adequate treatment.	4.4
	Ensure procedures are in place to ensure that pumping operations are supervised and monitored.	4.4
Dust control	Implement a dust prevention strategy.	4.5, 4.6
	Pave haul roads.	4.5
	Ensure adequate watering or treatment of areas that could give rise to dust.	4.5
Stockpiles and batters	Implement a management program to minimise erosion and sediment runoff from stockpiles and bare batters.	4.6
	Stabilise stockpiles and batters, if they are to remain bare for more than 28 days.	4.6
	Establish sediment controls around unstabilised stockpiles and batters.	4.6
Working in waterways and floodplains	Consult responsible drainage body for approval.	4.7

	Establish procedures to minimise impact on waterway.	4.7
	Design and construct stream crossings, if required, to minimise impact on the waterway.	4.7
	Ensure that written contingency plans have been prepared and adequately resourced.	4.7
	Prepare and submit a re-instatement plan to the relevant drainage authority for approval.	4.7
Noise and Vibration	Establish procedures that comply with limits on working hours.	5.1
	Implement procedures so that adjacent residents are advised of out of hours works.	5.1
	Regularly service machinery and vehicles.	5.2
	Reduce noise to acceptable levels.	5.2
	Schedule deliveries so that they do not cause impairment of local amenity.	5.3
	Install appropriate noise abatement structures, if required.	5.4
	Take measures to ensure that vibration does not impact on adjacent residents.	5.5
Waste minimisation	Implement a waste minimisation assessment.	6
	Set waste minimisation targets.	6
	Implement programs to reduce waste that needs to be disposed of.	6
Contaminated material and soil	Analyse material uncovered on site that could be contaminated or contain wastes.	7
	Establish procedures to excavate contaminated material or waste so as not to cause environmental problems, and seal remaining material.	7
	Establish and implement procedures for appropriate transport and disposal of contaminated material or waste.	7
Emergency procedures	Establish procedures for emergency situations.	8.1
Air Quality	Implement adequate maintenance regime for vehicle and machinery exhausts.	8.2
	Install controls on equipment or vehicles that are polluting the atmosphere.	8.2
Litter	Establish procedures to avoid the generation of litter.	8.3
	Install adequate litter bins on site.	8.3
	Implement staff awareness program.	8.3

Storage of chemicals and fuels	Establish procedures to minimise the quanities of chemicals and fuels required to be stored on site.	8.4
	Install bunding around storage areas.	8.4
	Implement adequately resourced contingency plans.	8.4
Road cleaning	Install wheel washes and rumble grids, as required.	8.5
	Implement a program for adequate cleaning of roads, if required.	8.5
	Install lined litter traps in side entry pits, if required.	8.5
	Ensure that trucks taking soil off site are covered.	8.5
Concrete batching plants	Obtain a Works Approval.	8.7
Inspections, monitoring and audits	Implement an adequate program of inspections, monitoring and audits.	9.1, 9.2, 9.3

EPA Publication 480