CONTROL OF EROSION ON CONSTRUCTION SITES

By Michael J. Ransom

SOIL CONSERVATION AUTHORITY
378 Cotham Road
Kew, Victoria, Australia, 3101

ISBN 0–7241–5457–4
SOIL CONSERVATION AUTHORITY

378 Cotham Road, Kew, Victoria,
Australia 3101

Chairman:
A. MITCHELL, M.Agr.Sc., D.D.A.

Deputy Chairman:

Secretary:
E. CATTACH, D.Bus. (Public Admin.)
FOREWORD

The land in and adjacent to our cities is an intensively used and important environmental area. It is now becoming sought after as prime industrial land because of its close proximity to population centres, markets and major transport links. It is land which is by no means problem free. During the construction phase of industrial developments it is often necessary to disturb large areas of land, which can result in erosion and sediment leaving those sites. Both nutrients and harmful chemicals can be transported in this sediment that can block roads, choke surrounding drains, waterways and pollute streams. It is not only a nuisance to local residents but costly to local councils whose responsibility it is to clear up the mess.

This booklet is designed as a guide for private construction firms, government and local government bodies to illustrate simple methods of minimizing land disturbance and reduce the amount of sediment leaving sites. I commend its use to all contractors involved in construction works to ensure that our environment is not spoiled.

R. A. MACKENZIE
Minister for Conservation, Forests & Lands
CONTENTS

FOREWORD 3

INTRODUCTION 7

1 CONTROL OF EROSION ON CONSTRUCTION SITES 9
   1.1 General 9
   1.2 How Does Erosion Occur? 9

2. BENEFITS OF EROSION CONTROL ON CONSTRUCTION SITES 11

3. PRINCIPLES OF EROSION CONTROL ON CONSTRUCTION SITES 12
   3.1 Planning Phase Controls 12
   3.2 Design and Construction Phase Controls 13
   3.3 Maintenance Phase Controls 14

4. CONSTRUCTION SITE PRACTICE 15
   4.1 Initial Clearing and Site Preparation 15
   4.2 Access Around the Site 16
   4.3 Drainage 19
   4.4 Stockpiles and Spoil Dumps 30
   4.5 Vegetation and Reclamation 31
   4.6 Batteries 34
   4.7 Sediment Trapping 37

APPENDIX 1. Construction Supervisor's Check List 46
APPENDIX 2. Soil Conservation Authority Offices in Victoria 47
REFERENCES 48
ACKNOWLEDGMENTS

A number of people have assisted in the preparation of this booklet, both in technical advice and in reviewing the text.

Particular thanks are due to a number of officers of the Soil Conservation Authority, particularly Mr. Graydon Findlay, the Authority’s Chief Engineer.

Also, the assistance of the following is greatly appreciated:

Mr. John Mapson, State Rivers and Water Supply Commission, Messrs. Cliff Lawton and Peter Nash of the Road Construction Authority, and Mr. Don Thomson and his staff of the Dandenong Valley Authority who assisted greatly in providing technical input and advice on the presentation of the booklet.
INTRODUCTION

Each year, an increasing area of agricultural and open land is converted to urban use for houses, shopping centres, factories, roads, schools and other facilities. At the same time, construction work is constantly proceeding on new reservoirs, highways, pipelines, power stations and other utilities. This process of change is not without cost. During the period of construction, land is disturbed and exposed to soil erosion.

This booklet is intended as a companion document to a larger manual, "Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria", also published by the Soil Conservation Authority. The Guidelines enable consideration of potential environmental problems caused by construction activities and provide information to design and install the erosion control techniques outlined in this booklet.

Many erosion problems can be solved simply, effectively and cheaply by using materials available on site. In fact, erosion control on construction sites usually pays for itself in the end, because not only are there less off-site effects such as siltation of streams and pollution of watercourses, but the site itself is more efficiently run.

For the contractor, a sure way of reducing productivity and increasing costs is to have men and machinery continually bogged down in mud. Heavy rain can cause havoc on a construction site. Half completed works may be washed out or buried in silt. Disturbed areas can become a sea of mud.

If any points in the booklet require clarification, contact the nearest Soil Conservation Authority office. A complete list of Authority offices is given in appendix 2.
1. CONTROL OF EROSION ON CONSTRUCTION SITES

1.1 General

Heavy rain can cause havoc on a construction site. Half completed work may be washed out or buried in silt. Disturbed areas can become a sea of mud and turbid water rushes off the site towards the nearest watercourse.

Engineering activities will be cheaper, more efficient and less harmful to the environment if attention is given to erosion and sediment control on the site.

1.2 How does erosion occur?

Rain, wind and the sea are continually eroding away the earth’s surface, and the resultant material is transported down towards the bed of the sea. Vegetation reduces erosion rates and helps to produce a system that is relatively stable.

When vegetation is removed, as on a construction site, soil erosion can occur at rates which are several hundred times greater than those existing in the natural situation.

For soil to be eroded, two processes must occur. Firstly, the soil has to be detached from the parent material and secondly, the detached soil has to be transported away from its original location. Soil particles are detached by raindrops hitting the bare soil surface and transported by run-off water flowing over the detached soil.

Some on-site effects of erosion on construction activities are:

● more run-off to be controlled on site.
● increased dust and visibility problems.
● more eroded soil deposited where it is a hindrance to construction activities.
● wet, muddy conditions during and after wet weather, which greatly increases down-time with machinery.
● more “tidy up” jobs such as de-silting drains or grading off eroded areas at the end of the project.

Some off-site effects of erosion on construction activities are:

● dirty, muddy water for users downstream.
● increased flooding frequency and volume of run-off.
● increased erosion of stream banks and beds.
● transport and deposit of sediment downstream.
● increase in water turbulence during peak flows causing uprooting of vegetation and destruction of aquatic life.
- reduction in stream flow during low flow periods.
- local erosion at the point of discharge of drainage water because of increased concentration and velocity.

Unchecked batter erosion

Erosion prevention through revegetation.
2. BENEFITS OF EROSION CONTROL ON CONSTRUCTION SITES

There are many on-site benefits resulting in planning and carrying out erosion control works on construction sites. These include:

- **LESS DOWN-TIME AFTER RAIN.** If a construction site is well drained and protected from run-off entering from outside the site, men and machinery will not spend much time after rain working in mud; less bogging of machinery will occur and people working on the site will be much happier. A sure way of reducing productivity is to have men and machinery continually bogged down in mud.

- **LESS CLEANING UP AFTER RAIN OR AT THE END OF A JOB.** If there have been few erosion problems on the site, there will be less culverts to be un-blocked, less drains to be de-silted and less tidying up at the end of a job. This can reduce costs by thousands of dollars on large projects.

- **FEWER COMPLAINTS BY DOWNSTREAM NEIGHBOURS.** If residential areas receive silt from a construction site, or if streams used for irrigation or water supply are made muddy, the construction organization very quickly, and quite rightly, receives complaints from downstream occupiers. It can be argued strongly that an organization working in one area of land does not have the right to affect legitimate land uses, or general conveniences of landholders further downstream.

Costs of erosion control are generally very small on construction sites. A job costing a total of $5,000,000 may only need $20,000 to $50,000 spent on erosion control works and these works, if carried out effectively, may save costs in the order of $100,000 to $200,000 over the life of a project. So the rule is – Soil Conservation Pays.

Attention to erosion control practices would have meant that this culvert did not have to be cleaned out.
3. PRINCIPLES OF EROSION CONTROL ON CONSTRUCTION SITES

3.1 Planning Phase Controls

A practical way of combating erosion is to plan control measures before work starts on a project.

An erosion and sediment control program is based on the following principles:

- Assess the erosion potential of the site before work starts.
- Control drainage coming in from outside the site.
- Control drainage on the site.
- Keep the area disturbed as small as possible and for as short a time as possible.
- Trap any sediment before it leaves the site.
- Retain topsoil for use in reclamation works.
- Revegetate all areas after earthworks are completed.

When deciding on the erosion control measures applicable for a particular site, the services of the Soil Conservation Authority are available. A complete list of Authority Offices throughout Victoria is given in appendix 2.
3.2 Design and Construction Phase Controls

Plans and specifications for a project should contain details of erosion and sediment control practices. The following points are indicative of the information that may be required as part of the detailed plans and specifications.

- Detailed soils information so that supervisors and operators know which areas are likely to erode and where special care is needed.
- Schedule of all earthworks, showing areas and approximate periods when the soil will be exposed.
- Measures proposed to control and dispose of run-off and sediment from the site.
- Plans for returning the topsoil and the planting of a vegetative cover.
- Standard of restoration to be applied to adjacent areas affected by the project.
- Control of access and access points to the site.
- Control of stockpile and spoil dump locations.
- Restrictions that may be required during wet or dusty conditions.

Success in controlling erosion on construction sites depends greatly on plant operators and their supervisors. Training on relevant aspects of erosion and sediment control should be provided for plant operators.

Sediment from this site will eventually end up causing problems further downslope.
3.3 Maintenance Phase Controls

The construction organization is normally responsible for maintenance of the site and control of drainage during the entire construction period. Maintenance for a limited stabilization period after construction is also normally required.

Typical maintenance requirements include:

- Fertilizing and re-seeding of grassed areas if necessary.
- Tree maintenance and re-planting.
- Correction of culvert levels, exit and entrances, if in error.
- Removal of silt and repair of eroded drainage lines.
- Repair of structures undermined or broken up.
4. CONSTRUCTION SITE PRACTICE

The following pages give examples of activities that can be carried out on construction sites to reduce erosion and sedimentation.

4.1 Initial Clearing and Site Preparation.

- Development should be programmed to minimize the area disturbed at any one time. Do not disturb the site more than is necessary and only strip areas which are going to be worked in the immediate future. It is tempting to clear the whole works area early, even though it may be 12 months or more before any works will take place on large areas. A lot of erosion can occur in that time. Overall, no money is saved by stripping earlier than necessary.

- Timber, logs and rubbish which will interfere with topsoil removal and respreading over the completed earthworks, should be removed.

- Before stripping topsoil, it is helpful to reduce the vegetative cover by grazing or mowing. Excessive grass or herbage makes topsoil removal and respreading more difficult.

- Topsoil and subsoil should always be handled separately and placed in separate stockpiles.

- Topsoil should be stockpiled for respreading on all exposed areas after final shaping has been completed.

Keep machine activity away from streams unless absolutely necessary and then keep machine activity in the stream to an absolute minimum.
4.2 Access Around the Site

4.2.1 Access Control

Make sure access is controlled on the site and that vehicles and plant keep to well defined haul roads or access tracks. If roads are poorly constructed, drivers and operators will tend to head for open country to keep away from rough or boggy areas, thus increasing the amount of bare ground on the site. Good access saves money by reducing the turn-around time of plant and by reducing the time lost in digging out plant which is bogged, etc.

Do not let plant and machinery go up and down batters. These areas can be quickly eroded into deep rills or gullies. Where temporary tracks are no longer required they should be revegetated and restored to their original drainage pattern. Do not have tracks wandering all over the site.

![Figure 4.2.1 Keep roads well crowned.](image)

Well constructed and well crowned haul road at the Road Construction Authority, Berwick by-pass construction site.
4.2.2 Some points to remember in road construction.

- Wherever possible, locate roads where earthworks are minimal.
- Locate roads where drainage is easiest, such as on ridges or gentler slopes.
- Locate roads at a safe distance from streams so that the sidecast material does not enter the stream.

Culvert crossings may be used on small drainage lines. They should be adequately protected up and downstream to prevent scouring.

On larger streams, bridges are necessary. Cross streams at right angles where possible.

Figure 4.2.2 Stream crossings can be corduroyed with logs or brush. Remove logs or brush when finished.
4.2.3 Entry and Exit to the Site

Many councils have by-laws which state that vehicles are not permitted to drop mud from their tyres on the road when they leave a construction site. Dirt on the road is a traffic hazard and when washed off the road after rain, it silts up drains and watercourses.

![Diagram of site entrance]

**Figure 4.2.3** Site entrance.

4.2.4 Dust Control

The movement of construction traffic over unsurfaced roads and areas should be kept to a minimum; haul roads should be sprayed with water, to which a chemical dust suppressant may be added.

![Photo of dust control by watering haul roads]

**Dust control by watering haul roads.**
4.3 Drainage

Control of drainage is one of the most effective ways of controlling erosion on a site.

4.3.1 Protection from Outside Run-off

The first priority in drainage control on a site is to make sure that natural drainage water from upstream is diverted around the site before work starts.

![Diagram of drainage control](image)

*Figure 4.3.1 Protection of construction site from outside run-off.*

4.3.2 Free Draining

Keep all bared areas free draining. Low areas on construction sites collect water and become very muddy. Not only is it difficult to work in such areas, but the mud may eventually get into streams causing muddiness of the water, and siltation of waterways.

4.3.3 Buffer Strips

Buffer strips of vegetation are very effective filters, causing the silt load to drop out of water leaving a construction site.
Figure 4.3.2  Buffer strips.

Vegetation left along river bank during construction at the Blue Rock Dam, Willow Grove. The vegetation acts as a buffer strip for sediment deposit, and also keeps machinery away from the river.
4.3.4 How to Build Diversion Banks

Banks may be either "all-fill" or "cut and fill" or combinations of both forms, and the principles of construction are similar in each case. These banks are used for diverting water away from construction sites. Section A7.42 of "Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria" sets out design procedures and where each type of bank should be used.

Figure 4.3.4 Construction of diversion banks.
4.3.5 Level Spreaders

A level spreader is constructed at the end of the bank, to ensure that channel flow is converted safely back to sheet flow.

![Level spreader diagram]

Figure 4.3.5 Level spreader.

4.3.6 Disposing Water Safely Down Batters

Slope drains dispose of run-off water from the work area down unprotected cut or fill slopes. They are used in conjunction with banks, or drains along the top edge of newly constructed slopes to prevent erosion. Plastic lining, wooden flumes, half round corrugated steel pipe, and rigid or flexible plastic pipes are commonly used.

![Slope drain down a batter diagram]

Figure 4.3.6 Slope drain down a batter.

22
Ditch liners can be built using plastic sheeting, old conveyor belt, etc. They are best used as temporary structures only.

Figure 4.3.7. Ditch liner.

Temporary and permanent slope drains protect slopes from erosion.
A method which has been used in New Zealand to dispose of temporary run-off is as follows.

The method involves using a very lightweight plastic cylindrical flume, about the same density as plastic bag polythene.

Run-off water is collected in low earthen diversion banks and directed to a disposal point. A short length, about 300 mm, of 100 mm corrugated polythene pipe is laid through the bank. The lightweight clear plastic flume is fitted over the corrugated pipe and secured by hayband or string.

![Diagram of flexible plastic flume slope drain](image)

**Figure 4.3.8** Flexible plastic flume slope drain.

The clear plastic flume is simply laid on top of the ground and occasionally secured with a wire loop. The loops prevent the flume from being blown about by wind. The flume can be extended for long distances, over precipitous and uneven terrain without any support.

A safe discharge point is selected (usually at the base of the slope) and the flume simply cut and knotted. Small holes are made towards the end of the flume to discharge the water without causing erosion.

Plastic flume is available in different diameters from 100 mm to 300 mm to suit different rates of run-off and catchments.

The lightweight flume would be particularly useful for temporary disposal of water from roadworks, gravel pits and construction sites until a vegetative cover is established.

### 4.3.7 Construction of Waterways

Waterways are defined channels where water is designed to flow. They may be used for diverting a stream, or for accepting flow from a construction site. If the flow is unlikely to carry a significant sediment load they should be grassed as soon as possible after they have been constructed.
Grass protects the waterway from erosion and allows higher flow velocities and steeper slopes than with raw earth channels. Section A7.435 of "Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria" sets out design procedures for grass waterways with parabolic or trapezoidal cross-sections.

![Parabolic cross-section](image)

*Figure 4.3.9* Typical waterway cross sections.

![Trapezoidal cross-section](image)

![Not recommended](image)

*Figure 4.3.10* Incorrect way of constructing a waterway.
This drainage line was constructed as a temporary by-pass to a construction site. Note erosion due to steep batters and lack of protective vegetation.

If run-off cannot be kept off the waterway until vegetation is well established, then the surface should be protected during establishment. Jute mesh or straw pinned under wire netting are suitable ways of providing temporary protection.

4.3.8 Jute Mesh and Bitumen Treatment of Waterways and Drains

Shape the drain to have as wide a bottom as required. Make sure the surfaces to be treated are well compacted. Sow and fertilize. Spray the surface with slow setting anionic bitumen emulsion at a rate of 0.5 to 1 litre/square metre. Lay jute mesh. Tamp or roll on to sprayed surface. Spray with bitumen at 2-3 litres/square metre.

All drums of bitumen should be topped up with fresh water and stirred thoroughly just before use.

The centrifugal pump and sprayer used to apply the bitumen should have water pumped through until it runs clear at the end of the day's work. Before storing, the pump should be filled with diesel fuel.
METHOD:
Prior to placing the jute mesh, the drain is to be trimmed, topsoiled, watered and sown with seed and fertilizer. Bury the top end of the jute mesh strip in a trench 150 mm in depth.

Tamp the trench full of soil. Secure with row of staples. Lay mesh along drain without stretching the mesh.

Overlap — bury upper end of lower strip as in 2 and 3. Overlap end of top strip 150 mm and staple.

Staple the mesh along each edge and centre with two pins on each edge and one in centre per metre of mesh.

Spray jute mesh with an application of slow setting anionic bitumen emulsion at 4.5 litres per metre length of mesh. A heavier application is to be made on edges and joins. When using two strips width, proceed as for single strip for each row. Provide 150 mm overlap between adjoining strips and staple along top edge between strips.

**Figure 4.3.11** Lining of Drains Using Jute Mesh and Bitumen.
4.3.9 Typical Drainage Control for a Construction Site

Figure 4.3.12 Drainage control on a typical construction site. Schematic view.
Figure 4.3.13 Plan sketch of an integrated drainage plan for a construction site. Most sites need at least some of these factors to maintain an erosion free and trouble free site.
4.3.10 Thatching of Waterways

Another way of stabilizing waterways and drains is by thatching.

- After the channel has been constructed, at least 50 mm of topsoil should be spread evenly over the area to be thatched.
- Seed and fertilizer is then applied to the topsoil.
- Hay or straw, to a depth of 50 mm, is then spread over the topsoil, and covered with wire netting.
- The wire netting is held down with galvanized wire staples, located at 400 mm centres both ways.

Further details can be obtained from the Road Construction Authority, Roadside Design Manual and Book of Standard Drawings.

4.3.11 Pumped Discharges

It is often necessary to pump out excavations after rain. These operations may be of such an intermittent or emergency nature that no formal control is possible. However, it is essential that people working on such jobs should be aware of the requirement to minimise the amounts of silt entering the drainage system.

Water should be discharged on to vegetated or surfaced areas, and not on to disturbed soils, fill slopes or stockpiles. Consideration should be given to using a vegetated area to filter the water or alternatively, construction of a temporary silt trap made of hay bales, etc. If possible, a standard procedure should be adopted for the particular project.

4.4 Stockpiles and Spoil Dumps

Stockpiles and spoil dumps can be major causes of erosion if they are not placed correctly. The following points give recommendations for correct, trouble-free handling.

- Topsoil for respreading should be stockpiled as close as possible to the job. Stockpiles of topsoil will often grass up naturally if left for a few months. They should be reasonably well compacted and the slopes can be roughened by moving a crawler tractor with cleated tracks up and down the slope so that the cleat marks are on the contour.
- The location of stockpiles and dumps should be controlled and kept away from drainage lines, floodways and culvert areas.
- Grassing or covering stockpiles of clay or subsoil should be considered if they are to be left over the winter. This can normally be done quite cheaply by sowing annual grass and clover seeds with fertilizer.
- If stockpiles are to be placed on sloping ground, they should be protected from outside run-off by constructing a diversion bank or drain around the upstream side so that run-off is disposed of safely away from the dump or stockpile.
- Stockpiles and spoil dumps should always be free draining. Large spoil dumps can be shaped and drained as shown in figures 4.3.12 and 4.3.13.
4.5 Vegetation and Reclamation

Vegetation is the best defence that can be provided to protect the soil against erosion. Vegetation alone will not eliminate all the problems of erosion and sedimentation, but when used in conjunction with good engineering practices, these problems will be greatly reduced. Vegetation should be established as soon after the completion of earthworks as the season permits. Regular maintenance with fertilizer is necessary. Failed areas will require re-seeding.

Vegetated Battens on the Road Construction Authority Mulgrave Freeway at Dandenong.

4.5.1 Selection of Treatment

Soil samples should be taken and analysed to determine any nutrient deficiency and to select suitable plant species. The Department of Agriculture and the Soil Conservation Authority are available for advice. The treatment will generally consist of:

- **Topsoil**: should always be replaced over earthworks before seeding takes place.
- **Ground preparation**: unless the soil surface is already loose, it will probably be necessary to cultivate it using a disc harrow, chisel plough or scarifier.
SCA Mulch Spreader and Aquaseeder on the Road Construction Authority Hume Freeway at Seymour.

- **Seeding:** seed may be broadcast by hand or by a mechanical spreader. The choice of seed mixture suitable to the soil and climate is important. The inclusion of clovers means that nitrogen is added to the soil and thus better plant growth is achieved.

- **Water:** plants will not germinate without water. In southern Victoria, where seeding is carried out in spring or (preferably) autumn, there normally will be enough rain to promote and sustain growth. Time of seeding is more critical in northern Victoria. Artificial watering may sometimes be required, but it can be very expensive and is usually only done on small areas. Seeding generally should not be carried out between early November and the end of February.

- **Mulch:** mulch may be hay, straw, woodchips, wood fibre, fibre glass or brush. Mulch keeps the soil moist and at an even temperature until the
vegetation is established. The mulch can be spread either by hand or by using a mechanical spreader. Hay mulch is usually spread at the rate of 3.5 to 5 tonnes per hectare (35-50 kg/100 sq m) which gives a loose thickness of 40-50 mm. Wood fibre is usually spread at the rate of 1.1 tonnes/ha (11 kg/100 sq m).

It is desirable to hold the mulch in position to reduce loss by wind and water, especially on sloping around. This can be achieved by:

* light discing into the ground.
* tracked dozer working up and down the treated area.
* using wire, jute or plastic netting, or strings, pegged to the ground.
* application of a slow setting anionic or cationic bitumen emulsion which is suitable for a wet or dry surface. Normal application is 2000 litres/ha (1 litre per 5 sq m).

**Fertilizer:** even in good topsoil, better results will be obtained if fertilizer is applied at the time of seeding; in all other situations, fertilizer is essential. The quantity and type of fertilizer should be determined by consulting with the Department of Agriculture or Soil Conservation Authority.

### 4.5.2 Special Treatment

**Mechanical mulching and seeding:** this is a very fast and efficient method of carrying out the grassing of large areas of bared soil. The SCA and private contractors have machinery available for this operation. Hydromulching requires sophisticated equipment and is carried out again by the SCA or specialist contractors. The contractor may have access constraints (e.g. the equipment may not be suited to off road operations and the spraying range may be limited) and will require large quantities of water. The most satisfactory and economical results will be achieved if heed is paid to the contractor’s advice.

**Sprig planting of grass:** sprig planting is labour intensive and suitable only for small areas. It may be used to establish grasses such as kikuyu or buffalo grass which do not reproduce easily from seed.

**Sodding:** sodding provides immediate protection in areas of critical erosion potential, such as batters and waterways. Suitable sods may be readily available on site. Block sods are used in restricted areas and strip sods on larger areas. Sod cutting machines are available. An elevating scraper can sometimes be used to cut sods and transport them to where they are to be planted. This can be done particularly with low growing plants such as kikuyu.

**Ground cover plants:** this is expensive, but may be the only method suitable for sand dunes and other sandy areas. Steep batters may require terraces to be formed using wire netting, timber slats or reinforcing fabric to hold the soil until the plants become established. Solid boards should not be used, since they form undrained terraces and may be subject to undermining.

**Tree planting:** expert advice should always be sought, particularly as to the selection and obtaining of species, and preparation of the ground before planting. The Forest Commission and the Natural Resources Conservation League can be of assistance in selecting species.
4.6 Batters

Exposed batters, because they are usually steep, can erode rapidly. While the surface may be protected by one of the methods described above, the resistance of the batter to erosion will be determined primarily by the engineering design.

Batters must be designed to satisfy stability criteria, with allowance for future maintenance. If the embankment is to be mown by a conventional tractor, a batter of at least 4H:1V is desirable for safety. Examination of existing batters in the locality will give a good indication of suitable slopes. Rounding of the top and toe of batters helps control erosion and permits easier mowing.

4.6.1 Cut Batters

Prior to excavation, a catch drain or bank should be constructed near the top of the cut, to prevent runoff water from beyond the batter reaching the exposed surface. As the batter is excavated, serrated cuts may be necessary to hold topsoil and assist with the establishment of vegetation. Temporary toe drainage should be maintained as the work progresses, with the permanent toe drainage installed when final depth is reached. Subsoil drainage should be provided, where necessary, to intercept seepage that would adversely affect slope stability.

4.6.2 Fill Batters

Permanent toe drainage should be installed at an early stage and discharged to a suitable outlet. At the completion of each work period, or at the onset of rain, a windrow of suitably compacted material should be constructed along the edge of the batter, to prevent drainage water from passing down the fill slope. Permanent top-drainage systems should be installed on completion of the filling operation.

4.6.3 Terraced Batters

This type of batter should be considered where the vertical height exceeds five metres. The width of each terrace or bench should satisfy stability requirements, with a minimum width of two metres. Each bench should be sloped inward and graded longitudinally, for drainage.

4.6.4 Retaining Walls

For batters in sensitive areas, the use of retaining walls may provide an economic and aesthetic solution.
NORMAL CUT OR FILL BATTERS

STEEP CUT BATTERS

VERY STEEP CUT BATTERS

Figure 4.6.1 Topsoil on batters.
Cut batter scarified ready for top soil.

VERY LARGE CUT OR FILL BATTERS

Width depends on access required

Catch drain

Table drain

Catch drain

Terrace
4.7 Sediment Trapping

A sediment trap operates by slowing or stopping run-off water at some point on its route, causing it to drop its sediment load. The outlet is therefore located near the top surface of the water in the trap or is by means of a filter membrane of material, such as crushed rock, which will strain out the sediment.

Even if erosion control practices are effectively carried out on a construction site, some sediment will inevitably be washed off earthworks. A silt trap will generally be needed at or near the final point of discharge from the site. They are also needed at other points, for example, below a concrete batching plant or below areas of earthworks which will be exposed for some time.

Eroded material entering a side entry pit on an urban subdivision during construction.
4.7.1 Small Temporary Sediment Traps

The following sketches and photographs show a number of ways of constructing temporary silt traps, which will be used for up to a period of 12 months.

FIGURE 4.7.1. Hay bale check dams used to trap sediment. Note that the bales are turned on their sides so that the strings do not rot quickly.

Hay bales can be used at culvert inlets to stop culverts from becoming blocked with silt. Road Construction Authority Berwick By-pass project.
FIGURE 4.7.2  Channel width determines the configuration of bales in small silt traps made of hay bales.
Figure 4.7.3 Alternative types of small sediment traps.
Figure 4.7.4  Two types of sediment traps at drop inlets.
4.7.2 More Long Lasting Sediment Traps

Some sediment traps may have to last for the life of a project which may be three, four or five years. These should be larger, so they do not need cleaning out as often, and be more durable.

Figure 4.7.5 Silt trap constructed of sand bags. Purpose of plastic hose is to allow the silt trap to partially dry out before the next storm.
Wing walls constructed of soil

At least 300 mm between top of crushed rock and top of earthen embankment

Front wall constructed of 25 mm screenings. Covered with wire netting and pinned upstream and downstream with tent pegs

The screenings will slow down sediment laden water during a storm, but let it slowly disperse and leave the sediment trap empty before the next rainstorm.

Figure 4.7.6 Silt trap constructed of earth, screenings and wire netting.
4.7.3 Large Sediment and Retention Basins

Figure 4.7.7 illustrates more sophisticated traps — sediment and retention basins — suitable for the principal discharge from a major construction site. Design of such basins can be carried out by referring to "Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria", published by the SCA.

SEDIMENT BASIN
Water retained until overflow occurs
allows maximum settling time

WET RETENTION BASIN
Water flow dependent upon water level.
Some water retained at all times.

DRY RETENTION BASIN
Water flow dependent upon water level.
Normally dry when not raining

Figure 4.7.7 Large sediment and retention basins.
4.7.4 Sediment Collection Barrier

Silt fences are especially useful for trapping sediment where access or right-of-way is limited beyond toe of slope. Silt fences are typically used at the following locations:

- along the toe of fills.
- adjacent to streams.
- along private property.

Figure 4.7.8  Sediment collection barrier constructed of hay bales. The barrier can also be built using a conventional post and wire fence, with filter fabric attached to the wire.
APPENDIX 1

Construction Supervisor's Check List

Has one senior staff or project member been assigned specific responsibility for co-ordinating and discussing erosion control? □

Can the Soil Conservation Authority assist with advice on erosion control on the site? (Officer’s locations are given in Appendix 2.) □

Does the contractor have an acceptable work plan that includes satisfactory provisions for erosion control? □

Has the contractor assigned an individual with adequate authority on site to work with project personnel supervising erosion control measures? □

What erosion control and sediment collection measures are required before clearing and other work is started? □

Is the contractor making sure he does not clear more land than is necessary for the job? □

Are joint field checks made by project and contractor personnel during rainstorms? □

Is maintenance satisfactory? □

Is the contractor completing stage work such as seeding and mulching, sodding, ditch paving or rip-rap as soon as practicable? □

Are erosion control measures and sediment trapping on spoil dumps and borrow areas satisfactory? □

Are haul roads and access tracks well drained and satisfactory for all weather use? □

Are photographs or reports needed to document actual job or adjacent property conditions? □

Have designers been invited to inspect the site to observe the operation or deficiencies in control measures? □
### Soil Conservation Authority Offices in Victoria

<table>
<thead>
<tr>
<th>Office Name</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAD OFFICE</td>
<td>378 Coatham Road, KEW, 3101</td>
<td>(03) 80 1381</td>
</tr>
<tr>
<td>ALEXANDRA</td>
<td>16 Downey Street, 3714</td>
<td>(057) 72 1433</td>
</tr>
<tr>
<td>ARARAT</td>
<td>Municipal Offices, Vincent St., 3377</td>
<td>(053) 52 2288</td>
</tr>
<tr>
<td>BACCHUS MARSH</td>
<td>Marsh Shopping Complex, Main Street, 3340</td>
<td>(053) 67 2922</td>
</tr>
<tr>
<td>BAIRNSDALE</td>
<td>State Public Offices, 210 Main Street, 3875</td>
<td>(051) 52 4775</td>
</tr>
<tr>
<td>BALLARAT</td>
<td>State Public Offices, corner</td>
<td>(053) 37 0626</td>
</tr>
<tr>
<td>BENALLA</td>
<td>22 Bridge Street, 3672</td>
<td>(057) 62 2466</td>
</tr>
<tr>
<td>BENDIGO</td>
<td>31 McKenzie Street, 3550</td>
<td>(054) 43 5740</td>
</tr>
<tr>
<td>BOX HILL</td>
<td>Suite 6, Whitehorse Plaza, 3128</td>
<td>(03) 890 0711</td>
</tr>
<tr>
<td>BROADFORD</td>
<td>High Street, 3658</td>
<td>(057) 84 4951</td>
</tr>
<tr>
<td>CHARLTON</td>
<td>33 High Street, 3525</td>
<td>(054) 91 1566</td>
</tr>
<tr>
<td>COLAC</td>
<td>State Public Offices, 83-85 Gellibrand Street, 3250</td>
<td>(052) 31 5799</td>
</tr>
<tr>
<td>COLENAINE</td>
<td>Whyte Street, 3315</td>
<td>(055) 75 2134</td>
</tr>
<tr>
<td>GEELONG</td>
<td>State Public Offices, corner</td>
<td>(052) 26 4819</td>
</tr>
<tr>
<td>GISBORNE</td>
<td>Shop 14, Aitken Street, 3437</td>
<td>(054) 28 2754</td>
</tr>
<tr>
<td>HAMILTON</td>
<td>62 Thompson Street, 3300</td>
<td>(055) 72 2777</td>
</tr>
<tr>
<td>HEATHCOTE</td>
<td>Hospital Street, 3606</td>
<td>(054) 33 2007</td>
</tr>
<tr>
<td>HORSHAM</td>
<td>State Public Offices, McLaughlan Street, 3400</td>
<td>(053) 82 3133</td>
</tr>
<tr>
<td>LILYDALE</td>
<td>Hardy Street, 3140</td>
<td>(03) 735 5766</td>
</tr>
<tr>
<td>MARYBOROUGH</td>
<td>Tullaroop Shire Offices, Neil Street, 3465</td>
<td>(054) 61 2021</td>
</tr>
<tr>
<td>MILDURA</td>
<td>State Public Offices, 253 11th Street, 3500</td>
<td>(050) 23 2906</td>
</tr>
<tr>
<td>OUYEN</td>
<td>17 Pickering Street, 3490</td>
<td>(050) 92 1322</td>
</tr>
<tr>
<td>PUCKAPUNYAL</td>
<td>Range Camp, 3662</td>
<td>(057) 93 1205</td>
</tr>
<tr>
<td>SWAN HILL</td>
<td>State Public Offices, corner</td>
<td>(050) 32 2984</td>
</tr>
<tr>
<td>WANGARATTA</td>
<td>State Public Offices, 64-66 Owens Street, 3677</td>
<td>(057) 21 5022</td>
</tr>
<tr>
<td>WARRAGUL</td>
<td>State Public Offices, Smith St., 3820</td>
<td>(056) 23 1589</td>
</tr>
<tr>
<td>WODONGA</td>
<td>Astra House, First Floor, Hovell Street, 3690</td>
<td>(060) 24 2788</td>
</tr>
</tbody>
</table>
REFERENCES


Urban Erosion and Sediment Control. Soil Conservation Service of New South Wales

Control of Erosion on Roadworks. T. J. Richmond

Processes, Procedures and Methods to Control Pollution Resulting from all Construction Activity. U.S. Environmental Protection Agency, Washington, U.S.A.


Environmental Considerations for Forest Harvesting. C.S.I.R.O.

Standards and Specifications for Soil Erosion and Sediment Control in Urbanising Areas. Maryland Department of Water Resources, Maryland, U.S.A.