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Bay of Plenty Regional Council

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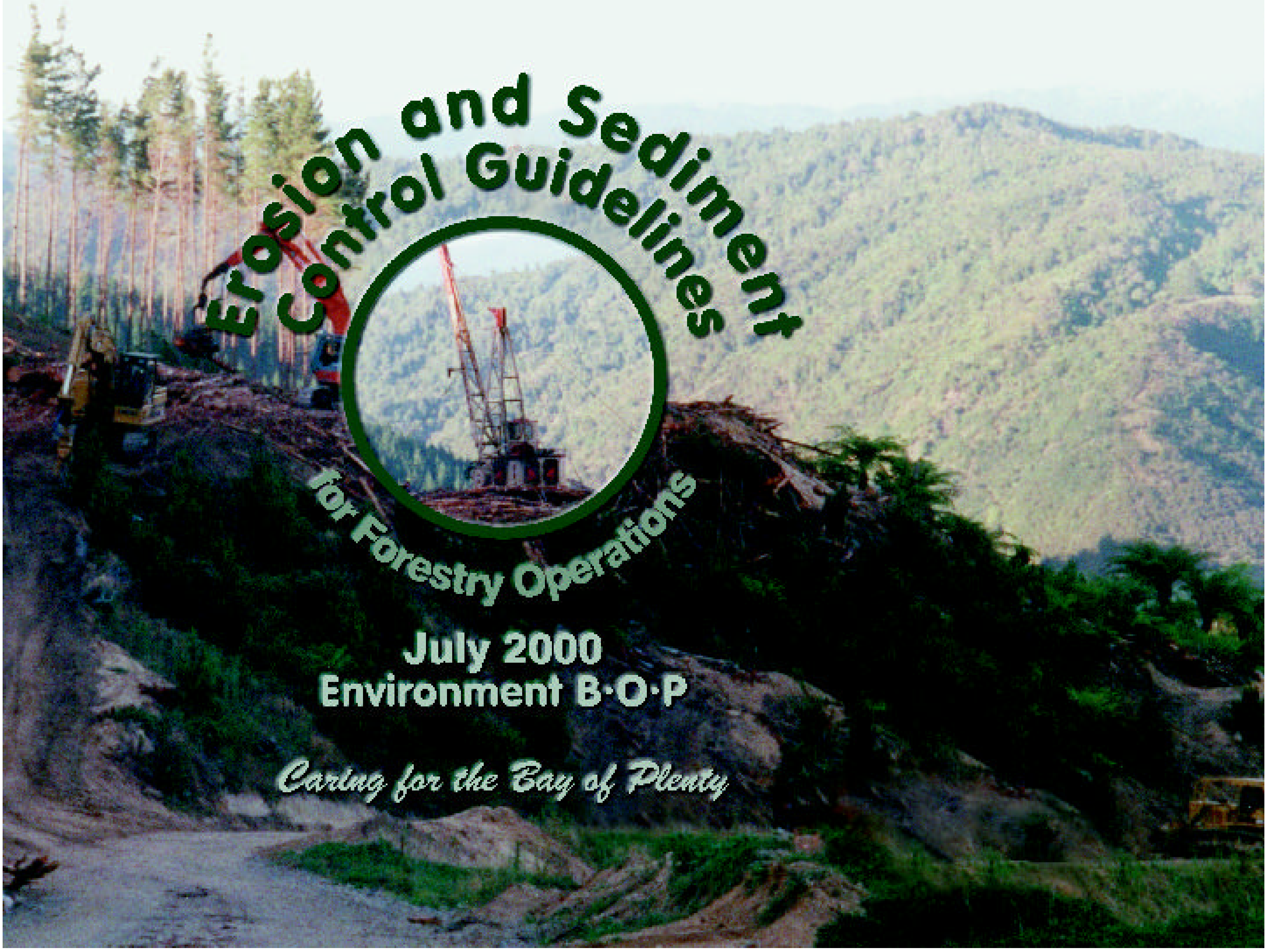

Erosion and Sediment Control Guidelines for Forestry Operations

July 2000
Environment B·O·P

Caring for the Bay of Plenty

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We would like to make a special acknowledgement to Auckland Regional Council. Their Erosion & Sediment Control Guidelines for Land Disturbing Activities have proven very useful as a model and guide to follow.

Contents

Chapter 1: Introduction

1.1 Intent of These Guidelines

These guidelines have two major objectives:

- Generally, to provide reference material on erosion and sediment control which can be used for a number of purposes, including education, regulation, and continuing environmental improvement.
- Specifically, to provide land users with comprehensive guidelines on erosion and sediment control which:
  - Outline the principles of erosion and sediment control.
  - Provide guidelines on particular land management activities to minimise erosion and sedimentation.
  - Provide specifications and standards for particular erosion and sediment control practices.

1.2 How These Guidelines Work

These guidelines replace the Bay of Plenty Regional Council Forestry Operation Guidelines that were first introduced in 1988, and updated in 1993.

The Guidelines are split into three main sections;

- The processes of erosion and sedimentation, and the principles for their control.
- Guidelines for planning and implementing forestry operations.
- Specifications for particular erosion and sediment control practices.

The first section provides useful background reference and educational information on **general principles** that should be considered when planning or carrying out forestry operations. The second section can be used as a **guide** for preparing consent applications, or when carrying out forestry operations where consents are not required. The third section provides **design specifications** for erosion and sediment control practices (commonly referred to as Best Management Practices or BMP's).

These may be used in consent applications, and/or cited as **minimum design standards** in consent conditions.

The appendices include an example of a harvest plan and a forest establishment plan that may form part of a resource consent application. In addition, a guide is provided to assist in establishing whether you require a consent for your proposed activity.

1.3 Erosion and Sediment Control in the Bay of Plenty Region

In the Bay of Plenty region there is a wide diversity of different land uses. Land disturbance activities which are potentially capable of causing erosion and sedimentation problems (such as earthworks, roading, and vegetation clearance), may occur under a range of different land uses. The erosion and sediment control measures outlined in this publication will apply to a range of different activities, within a production forestry land use.

Without satisfactory erosion and sediment control, some soils of the Bay of Plenty are very susceptible to fluvial erosion (erosion caused by flowing water), particularly from poorly controlled stormwater runoff. The water resources of the Bay of Plenty (the receiving environment) are valued for their high water quality, and wide range of potential use options. Therefore is important to ensure that accelerated erosion is avoided, and that mobilised sediment does not adversely affect water resources.

Sediment laden runoff can result in a number of off-site problems. The deposition of sediment into receiving waters from poorly managed land disturbance activities can have adverse ecological effects. These effects can include:

- Modified or destroyed in-stream values
- Modified estuarine or coastal habitats
- Smothering or abrasion of fauna and flora
- Changes in food sources and interruption of life cycles.

Recovery time for in-stream communities can be long term, ranging from months to years. In addition to this, there are potential problems of damage to assets such as pumps, and water supplies. An injection of sediment into a stream system is capable of initiating an erosion cycle which can be difficult to control. Localised flooding may result from sediment discharge, as well as unsightly damage in the form of debris and sediment. Suspended sediment can also provide a carrier mechanism for other contaminants such as pathogens.

A background level of sediment occurs naturally, but it is the elevated levels that are disruptive to the natural environment. By following the principles and practices outlined in this document, land users should be able to substantially reduce the adverse effects of land disturbance activities on the water resources of the Bay of Plenty.

The soils of the Bay of Plenty region are influenced by the volcanic parent material, particularly in the central and western areas. Many of the soils are formed from volcanic eruptions, and some are relatively young, with limited time for any substantial soil development. Often, the physical nature of the soils means that they are non-cohesive, friable, and easily worked.

In the Bay of Plenty, soil texture tends to be dominated by sand and silt, rather than clay. The resultant soils are often able to be worked and disturbed, using relatively simple erosion and sediment controls to reduce adverse off-site effects. There is generally less need for more stringent treatment that may be required for soils dominated by a higher clay content. However, the Bay of Plenty geology also means that there may be a deep mantle of volcanic ash showers with a range of different characteristics. Any land disturbance involving deeper excavation through different tephra layers in the soil profile, may be likely to disturb materials that have a higher clay content. In addition, there is a possibility of disturbing buried soils. In these situations, more stringent erosion and sediment control systems will be required to reduce adverse off-site effects.

1.4 Do I Need a Consent?

The Proposed Bay of Plenty Regional Land Management Plan - March 1998, (the Land Plan) sets out a number of rules that specify certain land management activities that require a resource consent. In addition, the Resource Management Act 1991 requires that resource consents are necessary for certain activities in association with river beds, the use of natural water, and any discharges.

Appendix I includes a brief explanation about resource consents, and has a series of flow charts for different activities, which help to explain whether a resource consent is required for different operations involving land disturbance. Under the Land Plan, the activities included in the flow charts either:

- require a consent, or
- are permitted, but must follow specified conditions.

If you are in doubt as to whether you need a resource consent for your proposed activities, contact an officer from the Bay of Plenty Regional Council (Environment B·O·P). Contact can be made by freephone 0800 ENVBOP, or 0800 368 267.

It is recommended that you contact the relevant district or city council to ensure that all requirements of the local council are met also.

1.5 When is Erosion and Sediment Control Required?

Erosion and sediment control should be considered whenever land disturbing activities (such as tracking or creating landings) or vegetation removal is undertaken.

When a consent is required, erosion and sediment controls form an integral part of the consent, and should be in place before any earthworks commence. In some forestry situations, where there is adequate vegetation or surface protection available, the erosion and sediment controls can be installed as works progress.

Following the completion of an operation, erosion and sediment controls should be maintained until the area is fully stabilised.

If a consent is not required, the erosion and sediment control guidelines and practices set out in this document provide a good general guide for matters that should be considered, to ensure that any proposed works do not create adverse environmental effects.

Chapter 2: The Process of Erosion and Sedimentation, and the Principles for their Control

2.1 The Erosion and Sedimentation Process

Erosion is a natural process by which earth is loosened and removed (usually by wind and rain). Natural erosion occurs slowly, but can be accelerated by human activities. The main factors influencing erosion include soil, characteristics, surface cover, topography and climate. It is normally human activities on the first three factors that causes accelerated erosion. The main forms of on site erosion within the Bay of Plenty are splash, sheet, rill and gully. Offsite erosion includes stream and channel erosion.

On Site Erosion	Off Site Erosion
Splash erosion Sheet erosion Rill erosion Gully erosion	Stream erosion Channel erosion

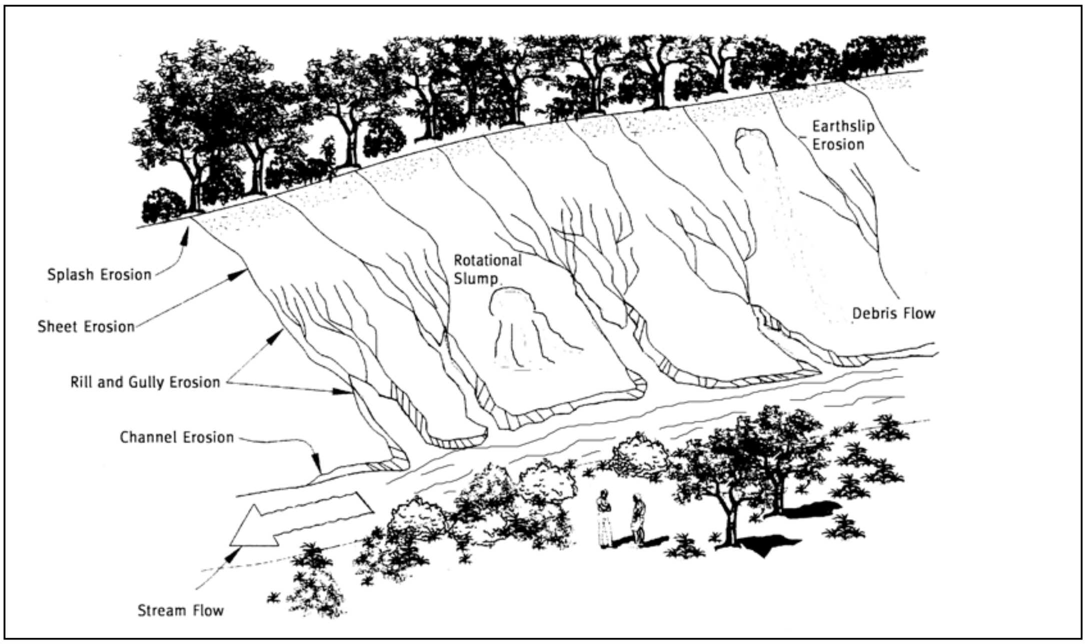


Figure 1 Types of Erosion Common in the Bay of Plenty Region

Sedimentation is the settling out of earth particles that have been transported by wind and water. The rate of deposition depends primarily on particle size and velocity of runoff. Heavier particles, such as gravel and sand settle out sooner than the finer particles such as silt and clay. Clay particles can become electro-statically charged due to turbulence, and can stay suspended in water for long periods, causing water to become cloudy or discoloured.

Stormwater runoff should be managed to minimised the volume and velocity of overland flows. This reduces the amount of sediment mobilised and the distance it is carried. To reduce water energy, the gradients of roads and landings should be kept as flat as possible. Cutoffs should be installed to keep the accumulated volume of water low. Keeping gradients as flat as possible will help to keep velocities low. This will, in turn, reduce the potential for erosion. There will be less turbulence, so larger particles being carried in suspension, will not be broken down as readily. Inexpensive low technology controls (such as, soak holes, or vegetation) can be used to encourage settlement of suspended solids in suitable areas.

In the Bay of Plenty, movement of pumice gives particular problems, because pumice is more buoyant than other materials. Sizeable pumice fragments may travel further downstream before settling, and may also cause blockage problems in smaller diameter culverts.

2.2 The Principles of Erosion and Sediment Control

The principles set out below provide general guidance on matters that should be considered in the control of erosion and sedimentation. Control is based firstly on protection of the soil surface from rainfall and stormwater runoff, and secondly on capturing eroded particles on-site. Because the finer particles can be difficult to capture once they are mobilised, the best way to control the generation of sediment is to prevent erosion. The following principles are effective in reducing both soil erosion and particle transport.

- Keep disturbed areas small and time of exposure short. Plan the construction activities so as to minimise the extent and duration that bare soils are exposed. Any land disturbance operations should take into account the season, and, in the case of short term sensitive operations, the weather forecast. This includes planning operations to stage construction works and limit the construction area of each stage. Stabilise disturbed areas quickly. Regardless of seasonal influence, look at revegetation as each stage is completed. If required, revegetation can be repeated in autumn or spring.

- Control erosion at source. Implementation of erosion controls should ensure stormwater velocities are low and mobilisation of sediment is minimised. Preventative control of erosion potential may avoid the need for more expensive sediment control measures. Methods include diversion bunds and channels on gentle grades, and using water as an energy dissipater (either backed up behind check dams or in soak holes). Compaction can also be used as an erosion control technique, but the ground surface should not be left smooth.

- Install perimeter controls. It is important to ensure that the disturbed area is isolated so that on site problems can be contained and controlled. This often involves keeping the works site divided into discrete catchment areas, so that clean runoff water (from undisturbed areas) is kept separate from sediment laden runoff (draining the disturbed areas). The boundary of the working area should be clearly marked using fences, flags, signs, high visibility tape etc. This should also help to ensure that machinery doesn't encroach into undisturbed areas.

- Retain sediment on site. Some erosion may be unavoidable. However, ensure that every effort is made to minimise the potential discharge of sediment off site. Consider the placement of sediment control measures before undertaking land disturbance activities, and install the controls before undertaking any large scale operations. Where possible, incorporate some detention of stormwater into the sediment control devices. For large scale earthworks, sediment control systems will require design input to ensure that they are able to cope with critical storm flows.

- Protect critical areas. Fit the development to the existing site conditions. This will require careful consideration on protecting steep slopes and watercourses. In addition, consideration should be given to retaining as much existing vegetation as possible to assist in erosion and sediment control, particularly to filter runoff. Clearance of native vegetation may require a specific consent.

- Inspect and maintain control measures. Specialist skills are required to install and monitor erosion and sediment control measures. Adopt a flexible approach, and continually assess your operations. Monitoring of the controls in the long term will ultimately result in improvements to design, and fine tuning of construction practices. To ensure that there is a feedback loop, it is advisable to have one person on-site responsible for construction and monitoring of the erosion and sediment controls. Ensure all weather access for inspectors and maintenance operations. Inspect the works during wet weather, so you can be sure that the stormwater runoff controls are functioning properly. Always consider the potential effects of the operations on the receiving environment. Continue to monitor the erosion and sediment control systems, making necessary changes to ensure that the effects are minimised.

Chapter 3: Guidelines for Forestry Operations

3.1 Planning

3.1.1 Introduction

Forward planning is an essential part of carrying out forestry operations. This includes planning to establish a forest from scratch, as well as planning before each stage of the forest rotation. The New Zealand Forest Code of Practice (LIRO) is a valuable tool for assisting forest owners/contractors in identifying any adverse effects of a particular operation, and then selecting the appropriate techniques to reduce potential impacts. Inadequate forward planning often results in higher cost in the long term.

Planning for forestry operations should involve the preparation of a physical plan showing necessary information and environmental constraints. This should include but not be limited to:

- The boundaries/areas covered by the operation,
- Topographical features and /or contours,
- Water bodies,
- Proposed earthworks, stream crossings,
- Proposed stream side management measures,
- Proposed haul direction (harvesting operations),
- Proposed processing areas
- Proposed erosion and sediment control measures,
- Environmental features (pa sites, protected reserves etc),
- Other features that need to be considered (public roads, electricity pylons etc).

Appendix II has examples of forestry plans for forest establishment and harvesting operations.

Planning should be undertaken by a suitably experienced person. Ideally, the contractor who will be responsible for carrying out the operation, should be involved in the planning phase. Otherwise, the person carrying out the planning needs to be fully aware of the possible constraints that will be encountered by the contractor.

To reduce potential impacts on soil and water values, one of the most important considerations for forest planning, is to tailor planting boundaries to match an appropriate proposed method of harvesting. This does not mean that detailed harvest planning is required before a forest is established, but consideration should be given to sensible planting boundaries, covering such matters as:

- Future access options for harvesting,
- General types of harvesting systems that are likely to be used,
- Environmental constraints that will need to be taken into account at harvesting.

It is important that the correct harvest system is chosen for the site as early as possible in the forest's rotation. This becomes particularly critical at sensitive sites where there is an increased risk of adverse environment effects, and the options for harvesting are limited.

> ➢ **Ensure planting boundaries are tailored to match an appropriate proposed method of harvesting.**
> ➢ **Ensure planning is undertaken by suitably experienced personnel.**

3.1.2 Operations

Many of the activities undertaken in forestry, require skilled operators. Regardless of how well an operation is planned, implementation is important to ensure that soil and water values are not adversely affected.

Erosion and sediment control relies on attention to detail when carrying out specific operations. The contractor is the key person to ensure that soil and water values are protected.

> ➢ **Successful erosion and sediment control relies on attention to detail**.

3.1.3 Monitoring / Maintenance

Within the Bay of Plenty, monitoring and maintenance of erosion and sediment control practices is a necessary part of their success in the short to medium term. During the operational phase, checks should be made of all erosion and sediment control structures, on a regular schedule, as well as after heavy rainstorm events. Consideration also needs to be given to how often the site will be inspected following completion of the operations. Erosion and sediment controls should be checked when operations are complete. They should be left in a suitable condition that provides for the level of follow up maintenance that will occur. For example, if a track will not to be used for a number of years, install deep cut-offs, or soakholes that will not require any maintenance.

Some areas will be critical because of their location or proximity to sensitive features. These sites need regular monitoring and maintenance of erosion and sediment control structures.

> ➢ **Successful erosion and sediment control relies on regular monitoring and maintenance.**

3.1.4 Streamside Management

Many operations carried out under a forestry land use, are potentially capable of having adverse effects on streams and other water bodies. Many of the potential effects can be reduced by forward planning and careful implementation. However, the risk of soil and water problems increases markedly, as operations are carried out closer to water bodies. The objective of streamside management is to avoid adverse environmental effects on streams. The main adverse effect is the discharge of sediment. The most foolproof method of addressing this potential problem is to manage operations near streams more carefully. This may involve a range of different options depending on site conditions. However, the common element to all options is that a specific management system is put in place when working near streams.

Control over the earthworks operations is important, with the control of stormwater being the key to avoiding problems. However, the simplest and most successful method of control, is to keep all earthmoving machinery well clear of streams. This can be achieved by marking “no go areas” near streams.

Control over logging residue can be simplified by choosing processing areas that have space available for logging residue or if establishing trees, by increasing riparian buffers between the trees planted and the waterbody. Impacts of harvesting include increased light, reduced shading following the removal of vegetation and potential for debris dams to form if slash is left in waterbodies.

> ➢ **Operations near streams, particularly earthworks and poorly managed logging residue have a high risk of causing adverse off site effects.**

3.2 Forestry Earthworks

Earthworks can be a major source of sediment, and potentially have the greatest impact on soil and water values. Under a forestry land use there is a range of earthworks operations that may be carried out. Guidelines for a number of those operations are covered in the following sections.

All earthworks should be carefully planned with regard to their location, construction, runoff control, and maintenance. Earthworks should generally be kept well clear of waterbodies, and out of lowest points within dry gully floors. Earthworks operations should be planned and implemented to move as little soil as necessary to complete the job, and the disturbed ground should be stabilised as soon as possible following completion of the works. Many earthworks operations will result in the formation of permanent assets. The degree of planning, and attention to construction detail, will often influence the effective working life of those assets.

3.2.1 Roading

Whenever practicable, roads should be constructed with as little soil disturbance as possible. This can be achieved by following ridge tops, natural benches and flatter slopes. Avoid constructing roads on steep slopes if possible. Where substantial cut and fill operations are necessary to meet grade and alignment requirements, sensitive areas, such as old erosion features or slips should be avoided. When planning the alignment of new roads, try to avoid crossing streams and dry gullies as far as practicable, by considering alternative options.

Where more significant earthworks are required, roading should be keyed into natural ground. Stability of cut and fill batters will be dependent on soil characteristics, and upper catchment runoff being diverted away from exposed surfaces. Fill slopes should be suitably compacted with consideration given to batter height, slope and surface stabilisation. Construction of benches is a method of controlling batter height and slope.

Runoff control should be carefully planned so that any discharge is controlled and directed to a stable outlet, such as a ridge, or through vegetation. Runoff should never be discharged directly onto fill slopes. However, runoff may be discharged over fill slopes using drop structures, flumes or piping. On roads with long continuous grades, runoff should be discharged in a controlled manner at regular intervals, before water velocities rise, and cause surface erosion problems.

Water tables may require lining with compacted graded rock where runoff cannot be safely discharged. Small check dams constructed of rock or sandbags may also be used to slow the rate of runoff.

On free draining volcanic soils, soak holes can be used to receive stormwater runoff. These should be constructed in series so that they are able to dissipate stormwater into the ground. Soakholes require regular maintenance and cleaning out, to ensure they are kept open and functional.

When new roads are being constructed, the operation should be staged, so that erosion and sediment controls can be maintained in effective working order. Stabilise cut and fill slopes as required by appropriate measures such as: seeding, compacting, benching, mulching or planting, or a combination of these. Install cutoffs and flumes to prevent scouring.

Avoid sidecasting operations when roading on steep slopes by considering other methods such as removing material off-site by end-hauling. Always use machinery that is suitable for the job, when carrying out road construction and maintenance. Unsealed roads on highly erodible volcanic soils will be susceptible to erosion of the road surface when the grade is over 7° (12% slope). In these situations, keep the lengths of steeper sections, as short as possible, and consider metalling the road surface to prevent erosion.

3.2.2 Tracks and Firebreaks

Tracks and firebreaks should be located to minimise the likelihood of debris and/or soil entering watercourses. Do not attempt firebreaking (by earthworks construction) on steep slopes which run directly into watercourses. If firebreaking is necessary in these situations, the firebreak should be formed without soil disturbance e.g. hand cut vegetation, then chemical spray / fire retardant.

Many tracks are temporary. They should therefore be carefully checked for potential erosion problems at the completion of operations. Avoid forming tracks that follow along the lowest point of dry gully floors.

Firebreaks and tracks should be maintained to a reasonable standard to control runoff, rilling and gully erosion. Construct cut-offs and/or soak holes at concentration points, as control measures. Avoid ponding of water above steep drop offs. If such ponding occurs, careful drainage design will be required to safely discharge the water, without causing gully erosion problems.

3.2.3 Landings

Landings may be permanent assets or temporary formations. However, if they are constructed in conjunction with careful harvest planning, it is likely that future harvesting operations will use the same landing sites. It is therefore important to construct landings so that they are well drained and stable. This will provide the basis for a suitable landing to be constructed at the same site in the future.

Landings should generally be kept well clear of streams. However, when there is no alternative to locating one near a waterbody, ensure that the waterway is not obstructed. Form the landings so that water flow is directed away from the waterbody. Use well compacted earth bunds as a barrier between the stream and the landing. Incorporate other measures wherever possible to help control stormwater runoff; e.g. soak holes in stable areas, existing vegetation, etc.

Where practicable, harvest those trees located between the landing and the waterbody prior to the time of construction. This will avoid the earth bund along the edge of the landing being damaged, if the trees are logged after the landing is formed. Ensure that production trees are not planted between the landing and the stream in the next rotation.

Most problems at landings (processing sites) occur after logging is completed, due to failure of run–off controls. Landings should be inspected regularly and maintenance undertaken if necessary until site is effectively stabilised (this may take up to five years).

- **Steepness and length of slope, placement of fill, and management of runoff are critical factors in assessing erosion potential.**
- **Ensure exposed ground is stabilised as soon as practicable following completion of earthworks, using hydroseeding or mulching if necessary.**

3.2.4 Stream Crossings

Most stream crossings will require a resource consent, before they can be constructed. However, some small stream crossings will be able to be constructed as a permitted activity as long as specific standards are complied with.

All stream crossings should be constructed in a manner that causes minimal disturbance to waterbodies and their adjacent protective vegetation. Wherever practicable, watercourses should be crossed at right angles, on a straight section of the stream. The approaches to the crossing should be constructed at a gradient which is less than 10° (16% slope) where possible. The approaches should also be stabilised with aggregate or other suitable material, as soon as construction is completed. Runoff controls and fluming should be used to ensure that stormwater is not discharged onto any loose fill associated with the approaches or abutments. The abutments should be stabilised, using appropriate methods (e.g. rock protection, compacting, benching revegetation). Batter slopes should be designed so that they are stable and not likely to collapse, with the culvert length designed in conjunction with achieving a stable batter slope. Avoid constructing stream crossings during winter, prolonged wet weather, or during the fish spawning or migration periods. If necessary, rock rip-rap or similar flexible material may be required to prevent erosion of the culvert outlet, as well as ensuring fish passage is not impeded.

Minimise the use of temporary crossings. When temporary crossings are necessary, lightweight temporary culverts, which fit the channel size as closely as possible, should be used. While log crossings are discouraged, they may be appropriate in particular situations such as where streams are small, suitable logs are available, and soil is not dragged across the crossing when logs are pulled.

Major bridges and culverts should be constructed during periods of normal low flow. Ensure that all materials, machinery, and workers are on hand before commencing construction of any stream crossing. Ensure that no machine refuelling or fuel storage occurs where there is the potential for a fuel spill to enter a water body.

Further information concerning structures in watercourses can be obtained from Environment B·O·P.

- **Always use appropriate machinery for the construction of a stream crossing.**
- **Construction of stream crossings should be supervised by a suitably experienced person.**

3.3 Land Preparation

There is normally a requirement for some form of land preparation prior to establishment of a plantation forest. This may include disturbance of the ground surface, desiccation or removal of existing vegetation, or a combination of both. The purpose of land preparation is to provide suitable conditions for the establishment of the forest crop. Some land preparation activities increase the risk of soil erosion for a short period of time.

3.3.1 Mechanical Land Preparation

Mechanical land preparation should be carried out on the contour as much as possible to minimise runoff being concentrated down the cultivated lines. Where downhill runs are unavoidable, limit them to 50 metres (approximate) maximum length. Do not attempt these runs on slopes that are too steep for the tractor to reverse back up. Blade or rake at least one line on the contour along the lower boundary of downhill operations. This will help prevent runoff concentration at low points or gullies. Finish downhill runs well before any fill batter slopes e.g. landings, access roads. Always leave an undisturbed strip beside waterbodies.

If carrying out cultivation on landings, cultivate or rip the landings across their general slope. Repair or reinstate drainage channels and cutoffs after any mechanical preparation. Be particularly careful near roadside edges.

Do not push slash from windrows or firebreaks into waterbodies. Align windrows of slash along the contour of sloping land. This will help form a barrier and filter for trapping sediment.

Where land preparation is undertaken, use roller crushing methods rather than cultivation where possible and only use ridge tracking for access on steeper slopes.

When working near waterbodies, gullies or drop-offs, work along the contour. Always inspect the site at the completion of operations for areas that will potentially erode.

3.3.2 Weed Control (Herbicide)

All herbicide operations should comply with the current *Agrichemical Users' Code of Practice*. This provides working guidelines to a New Zealand Standard. The *Agrichemical Users' Code of Practice* sets out matters such as storage of chemicals during operations, cleaning of containers, and removal of material and containers off-site.

All herbicide operations, particularly aerial, must be planned and carried out to avoid spray drift on to waterbodies, and their adjacent protective vegetation zones.

A resource consent, under the Resource Management Act 1991, is required before herbicide can be sprayed over water. If spray drift is a problem, an air discharge permit may also be required, under the proposed Bay of Plenty Regional Air Plan.

Environmentally sensitive areas can be spot sprayed instead of blanket sprayed. It may be possible to schedule aerial operations so that sensitive areas that are blanket sprayed can be successfully oversown with grass/legumes before winter.

Arrange to have water available for mixing the chemical, well away from any natural water. Minimise the risks of chemical being spilt on the ground, or entering natural water.

3.3.3 Burning

Burning can have significant adverse environmental effects, both on-site and off-site. Careful control over burning is required to ensure that the burn does not spread beyond the target area. Burning may require consents from the Regional Council, and local Fire Authority (which may be the District Council, Department of Conservation, or Forestry Company). Always check with both the Regional Council and District Council to ensure you are aware of all the necessary consent requirements.

Generally, burning is not encouraged as the adverse environmental effects can be significant. However, if alternative methods are not suitable, and burning is used, then protected areas must be clearly identified and safeguarded. Burning techniques that leave designated areas of protected vegetation intact, should be employed. In critical sites, such as on steep slopes or in proximity to water, burnt areas should be immediately oversown in a suitable grass/legume mix to reduce the risk of surface erosion. Firebreaks and tracks associated with burning operations should follow the guidelines set out in section 3.2(b). Alternative methods to burning include mechanical land preparation (on flat to easy slopes), cutting lines or light wells manually, herbicide application, roller crushing and intensive cattle grazing.

3.4 Planting and Tending

3.4.1 Planting

Planting operations are generally not an environmental problem. However, the future impacts of harvesting those trees can be a problem in certain sites. Planting in some catchments, may affect stream flows in the long term.

With any new forest establishment, planting boundaries should be set to minimise the impacts of future harvesting operations on water bodies, gullies, and erosion prone land. Planting boundaries on clearfell sites should also take account of past logging difficulties. Boundaries should be set with due regard to topography, and soil stability, and set on a case by case basis. As stated in section 3.1.1, planting boundaries should be tailored to match an appropriate proposed method of harvesting.

Wherever possible, the unplanted zone between the production crop, and the waterbody/at-risk area should be left to regenerate naturally, to protect water and soil values. In some cases, the active planting of protective species may be appropriate to control erosion or hasten revegetation. Any regeneration from a previous crop, or adjacent production stands, should either be removed (before growing too large), or left and treated as being for protection only, and not production.

Where burning or herbicide application destroys protective vegetation outside of the designated planting boundaries, production planting should still be kept to the designated boundaries. In these situations, it may be appropriate that suitable protection planting be carried out in the areas accidentally burnt, as a means of mitigation.

Where there are environmentally sensitive sites, it may be appropriate to have areas designated for protection which will not be planted in production species. This creates a clear boundary of production areas and protection areas. Another option for sensitive areas, is to use species that require specialised management, rather than lose all production from a marginal site. Options may also include planting longer rotation species. Grazing of livestock, (particularly cattle), within the unplanted/protection zones, should be discouraged.

3.4.2 Tending

Generally, the effects of tending operations on water and soil values are minor, particularly if the forest operations have been well planned and executed.

Forest owners and managers should ensure that no slash from pruning or thinning operations enters any streams or watercourses. Furthermore, there should be no contamination of natural water from chemicals and fertilisers. Any earthworks associated with tending operations should follow the relevant guidelines in section 3.2. Activities such as production thinning and thinning to waste, should follow the guidelines in section 3.5 on harvesting.

> ➢ **Carefully consider the impacts of planting and tending operations on stream values.**

3.5 Harvesting Operations

3.5.1 Planning

The need to carry out planning prior to harvesting is vital. If harvesting is well planned, the roadlines, stream crossings, and landings will be located so that the area can be harvested in a similar manner when the next rotation is ready for harvesting and any adverse effects of soil and water will be minimised.

A harvest plan should include the location of proposed roading and stream crossings (including standards and pipe sizes), landing locations, recommended skid trails or hauler settings and special precautions to be taken in sensitive areas. All streams, historic sites and other features that will need to be considered (such as swamps, electric powerlines, gas lines, waahi tapu etc.) should be noted.

Harvest planning should involve the proposed contractor if possible, and the preliminary work should include a thorough site inspection. Aerial photos, contour maps and clear indications of property boundaries, will assist in the harvest planning process.

3.5.2 Felling

When trees are being felled within reach of a waterbody, ensure that an experienced logger is in control of the operation. Where practicable and safe, fell or back-pull trees away from watercourses, particularly on steep or unstable slopes or edges.

Where trees cannot be felled or back pulled away from a waterbody, fell them directly across the watercourse. Extract the trees before trimming them. Avoid putting debris such as debris or slash into a waterbody.

Ensure that stream flow is not dammed by logging debris. Remove any logging debris that is likely to cause a blockage or obstruction of the watercourse.

3.5.3 Extraction

In general, landings should be located so that extraction is away from waterbodies and sensitive areas.

(a) **Ground-based systems**

Keep tracking and stumping to a practical minimum. Use a few carefully chosen tracks and stay on these, rather than taking shortcuts that may cause unnecessary ground disturbance.

Carry logs off the ground, or on the machine wherever possible. Keep the machine blade up, and do not bulldoze soil and stumps needlessly.

Do not haul through or along streams. However, if the operation necessitates the extraction of logs across a stream, and there is no alternative route, then use a permanent or temporary crossing (See section 3.2.4). Avoid pushing standing dead trees into streams.

(b) **Cable systems**

If cable systems are used in environmentally sensitive areas, wherever practicable, keep the settings small, the haul distance short, and the hauling direction uphill. Avoid cross-slope haul-lines that damage areas of protective vegetation or sweep slash and soil into waterways. Where possible, lift logs clear of these areas, and always use the appropriate machine and carriage to suit the site. If environmental damage is excessive, consider permanent retirement from afforestation.

Avoid forming log channels or furrows that direct and concentrate runoff towards a stream.

3.5.4 Slash and Residue Management

Prior to harvesting operations commencing, there should be some assessment of whether large volumes of slash and residue will be produced, following on-site processing. Where possible, you should delimb on cutover to minimise slash build up at processing sites. The amount of debris produced as waste, will largely depend on the silvicultural regime that has been practised over the rotation of the forest crop. If large amounts of slash and residue will be produced, then contingency measures to deal with the volume of material will need to be put in place.

Slash and residue from the processing operations can cause problem “bird nests”, if not managed in a proper manner. With all slash and residue disposal, the overburden material will collapse over time, as the woody debris rots down. Disposal sites for slash and debris should be carefully located in designated areas, and marked on site for clear identification. These areas should be on stable land, well away from steep slopes, fill material, slips, gully heads, and riparian areas. This will reduce the likelihood of adverse off-site effects.

The use of two staging operations, with the main processing site on easy stable ground, may allow for easier management of slash and residue material. Other options for disposal of slash material include processing, burning, or removal off-site.

- **Plan your harvest, then harvest according to your plan.**
- **Use trained, and appropriately skilled and experienced operators, with the correct machinery for your operation.**
- **Carefully consider the placement of slash and residue to minimise adverse effects.**

3.6 Post Operational Management / Maintenance

3.6.1 Management

On completion of harvesting operations, ensure that the following matters (where appropriate) are addressed:

- Remove any logging debris from waterbodies either by hand, or with appropriate machinery, while avoiding bank disturbance and/or deepening of the stream channel.

- Remove and rehabilitate all temporary crossings.

- Construct cut-offs and/or water bars and/or soakholes on extraction tracks, haul paths and firebreaks.

- Ensure there is adequate drainage provided on landings, and ensure that debris from landings is unable to enter any streams.

- Slash and logging residue should be placed in stable position to minimise the potential to collapse and adversely affect streams.

- Vegetate and/or stabilise any exposed sidecast material, or fill batters on earthworks sites.

- Ensure that runoff is channelled safely over batter slopes and onto stable areas.

- Remove all non- biodegradable waste from the site (e.g. wire rope, paint cans, fuel/oil containers, old chains, plastic containers etc.).

3.6.2 Maintenance

Post operational maintenance of earthworks is of primary importance. A regular maintenance programme should be put in place, to ensure that erosion and sediment controls continue to function properly.

Ensure that there is proper control of stormwater runoff, and the systems are capable of working well between inspections. It may be better to over design the systems that will be checked less often, e.g. allow for larger soakholes, deeper cut-offs etc.

When undertaking grading of roads, ensure that soakholes, flumes, and drainage channels are not blocked by the grader. Inspect after grading to ensure that all drainage systems are working. Check that culverts and bridges are not blocked or scoured out. Landings, haul paths, tracks and fire breaks are often problem areas, because they are seldom used again after an operation is completed. In some instances, ongoing maintenance of earthworks may be required until the cut over/establishment area is fully vegetated and stabilised. Vulnerable areas should also be inspected after heavy rain storms.

Chapter 4: Erosion and Sediment Control Practices

4.1 Runoff Diversion Bund/ Channel

4.1.1 Definition

A non-erodible channel and bund for the conveyance of runoff, constructed to a site specific cross section and grade design.

4.1.2 Purpose

- To intercept clean runoff above a construction site and divert around the works area, or
- To divert sediment laden water to an appropriate safe outlet or sediment retention structure.

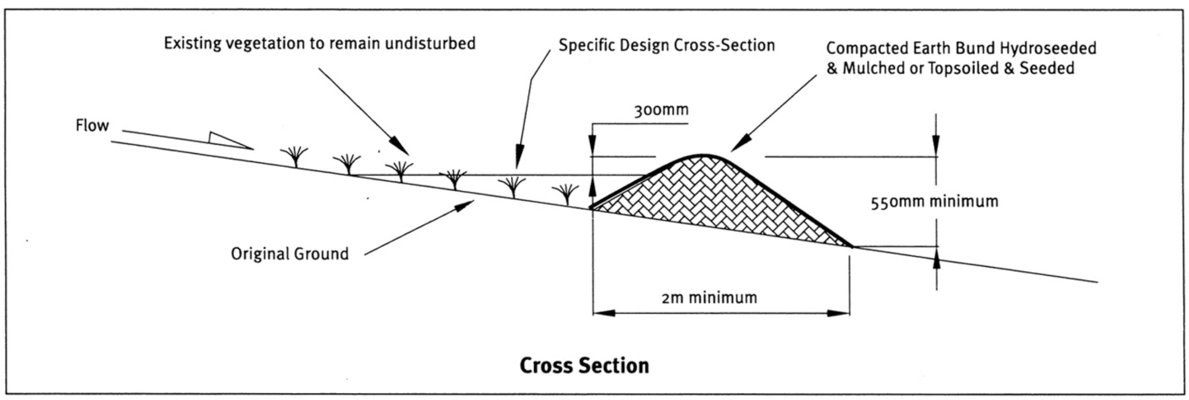


Figure 2 Cleanwater Runoff Diversion Bund

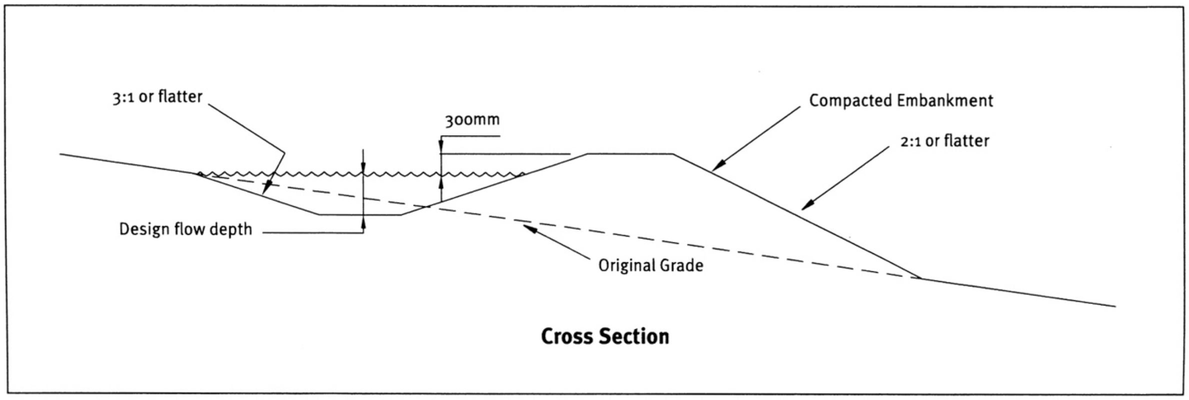


Figure 3 Run off Diversion Channel

4.1.3 Application

Runoff diversion channels/bunds are used in the following forestry situations:

- To divert clean runoff water above landings, and divert to safe outlet(s).
- In either temporary or permanent situations.
- Around the perimeter of a landing or road, to prevent sediment and logging debris from leaving the area.
- Along the lower perimeter of a landing, to divert sediment laden water to a controlled outlet or sediment treatment area (such as a soakhole or vegetation/slash area).

4.1.4 Design/Construction Specifications

There are many designs for runoff diversion channels/bunds. However, the following points cover the main design criteria.

- Design the runoff diversion channel to carry the flow for at least a 5 year return period storm, allowing for freeboard.
- Restrict grades to no more than 2% unless the channel is armoured with aggregate, or protected with geotextile.
- Ensure that the channel empties into a stable erosion proof outfall.
- Construct the bunds so that they are at least 300 mm metre high, and keyed into natural ground.
- Ensure the bunds are well compacted, and vegetated or hydroseeded.
- Construct with a trapezoidal cross-sectional shape for the channel.
- Ensure the internal sides of the bund are no steeper than 3:1, and the external sides no steeper than 2:1.

4.1.5 Comments

Note that bunds to divert clean water runoff, should be constructed using material (topsoil) from within the disturbed site, and minimising the disturbance to existing ground cover where the clean runoff water will flow.

As all runoff diversion channels/bunds rely on a stable erosion proof outlet, this should be the first consideration when they are sited and surveyed. Always carry out surveys starting from the chosen outlet point. The survey line can then be made on the correct grade to safely pick up runoff water.

Consider where excess runoff will drain to, if the design storm is exceeded, and the bund is overtopped. Allow for a safety overflow in the most appropriate location.

Bunds need particular care to protect against damage from adjacent operations such as harvesting and should be reinstated if damaged.

4.1.6 Maintenance

Runoff diversion channels/bunds need regular maintenance to keep functioning throughout their working life. Regular maintenance consists of the following.

- Inspect after every rainfall and during periods of prolonged rainfall for scour, sediment build up or weakening of the bund wall.
- Repair any storm damage immediately.
- Remove any sediment deposited in the diversion channel, and from the outlet area if necessary.
- Carefully check outlets for scour and erosion problems.

4.2 Contour Drain

4.2.1 Definition

A temporary ridge or excavated channel, or combination of ridge and channel, constructed to convey stormwater runoff safely across sloping land on a minimal gradient.

4.2.2 Purpose

To intercept overland flow on exposed sloping ground, thereby limiting slope length and reducing the erosive power of the runoff, and to divert the sediment laden water to stable outlet areas. In non-cohesive ash and pumice soils, some overland flow will be lost to ground soakage.

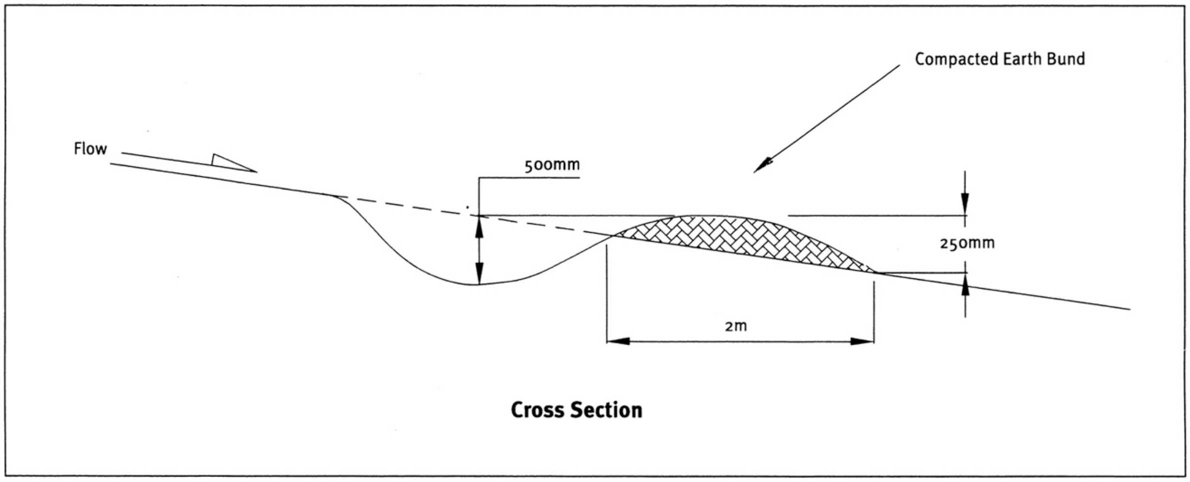


Figure 4 Contour Drain

4.2.3 Application

Use contour drains in the following situations:

- At intervals across disturbed areas to shorten overland flow distances.
- As temporary or daily controls.
- To split and direct flow from disturbed areas to runoff diversion channels/bunds.
- To direct flow to safe disposal areas such as vegetation.

4.2.4 Design/Construction Specifications

The following points cover the design criteria for contour drains:

- Ensure that gradients are less than 2%.
- Ensure the channels and ridges of the contour drains are well compacted.
- The length of contour drains should be kept as short as possible. Ideally they should be 20 to 40 metres maximum length.
- Ensure that the outfall of the contour drain is stable.
- The spacings between contour drains will vary according to slope of the ground as shown on the following table.

4.2.5 Positioning of Contour Drains

Slope of Site (%)	Spacing of Contour Drains (Cohesive soils)	Spacing of Contour Drains (Ash and pumice soils)
5	50 m	30 m
10	40 m	20 m
15	30 m	10 m

4.2.6 Comments

Ash and pumice soils are non-cohesive, and very susceptible to rill and gully erosion. The spacing between contour drains on the ash and pumice soils, are therefore much closer than in cohesive soils. Contour drains are generally of a temporary nature and should be used to control runoff on landings until the ground surface is stabilised. As contour drains are not designed to carry a specific flow, maintenance of the drains is critical.

4.2.7 Maintenance

- Install contour drains at the end of each day, or at the end of a stage of work, to control overland flow, while the area becomes vegetated or otherwise stabilised.

- Ensure that the outlet remains stable.

- Inspect contour drains after every rainfall and during periods of prolonged rainfall.

- Use sandbags during rainfall events, if extra height is required on the ridges of the contour drain. Revisit the site after rain, to tidy up any maintenance carried out during the rainfall event.

- Carry out maintenance work immediately, if any work is required.

4.3 Water Bars/Cutoffs

4.3.1 Definition

An excavated channel / ridge combination across a road or track to control and divert stormwater runoff to a safe outlet. Known as water bars or cutoffs, but will be referred to as cutoffs in this section.

Figure 5 Water bars/Cutoffs

4.3.2 Purpose

To control stormwater runoff on a road or track, and divert it safely to a controlled outlet so that the surface of the road or track is not subjected to rill and gully erosion. In non-cohesive ash and pumice soils, some overland flow will be lost to ground soakage.

4.3.3 Application

Use cutoffs in the following situations.

- At intervals across roads and tracks to shorten overland flow distances.
- As temporary or daily controls on haul tracks in critical situations.
- To direct flow from road and track surfaces to safe disposal areas such as vegetation.
- Install on temporary tracks when they are decommissioned.

4.3.4 Design/Construction Specifications

The following points cover the design criteria for cutoffs:

- Ensure that the gradient of the cutoff across the access track has sufficient fall to divert and convey stormwater runoff to the safe outlet. The gradient is critical, as the velocity of the runoff flowing down the track may result in overtopping the cutoff to continue flowing down the carriageway.
- Ensure the channels and ridges of the cutoffs are well compacted.
- Ensure that the outfall of the cutoff is stable.
- If cutoffs are installed on the decommissioning of temporary tracks, ensure that the spacings and sizing of the cutoffs are over designed so that maintenance will not be necessary. Cutoffs should be excavated to at least 0.5 metres, to minimise risk of failure.
- If the track is decommissioned, and maintenance is unlikely, sow grass seed on the cutoffs so that they become revegetated.
- The spacings between cutoffs will vary according to slope of the ground as shown on the following table.

4.3.5 Positioning of Water Bars/Cutoffs

Slope of Site (%)	Spacing of Cutoffs (Cohesive soils)	Spacing of Cutoffs (Ash and pumice soils)
Up to 12%	40 m	30 m
From 12% to 30%	30 to 20 m	20 to 10 m
Over 30% slope	Less than 10 m	Less than 10 m

4.3.6 Comments

When setting out cutoffs, always ensure that the outlet is stable. This may require the installation of fluming to convey runoff water safely over fill slopes. As with diversion drains/earthbunds, survey your grade from an identified stable outlet whenever possible.

Always run cutoffs so they drain towards the outside of the track. If the track is sloped inward towards the inside bank, cutoffs should not be used, but the water table may need compacting or armouring.

Ridges will generally provide more stable outlets than gullies, because the access track will be sited on fill material over the gully.

As with contour drains, the cohesiveness of the soils on the track surface should be taken into account, when setting the spacing between cutoffs. If the track is not compacted, and the soils are coarse ash or pumice, the cutoffs will need to be more closely spaced.

If the soils are very porous, the gradient of the channel along the cutoff can be reduced, to encourage more soakage to ground.

4.3.7 Maintenance

The following points on maintenance are critical to the cutoffs continuing to fulfil their intended function. If one cutoff fails, the resultant overflow will aggravate erosion problems and may place pressure on other structures further down the access track.

- Ensure that the outlets remain stable and clear of sediment.
- Inspect cutoffs after every rainfall and during periods of prolonged rainfall.
- Carry out maintenance work immediately, if any work is required.
- If there is rill or gully erosion on the track, then more cutoffs will be required.

4.4 Soak Holes

4.4.1 Definition

A constructed hole which acts as a soakage bay, whereby stormwater runoff is collected and left to soak into the natural ground.

4.4.2 Purpose

To control stormwater runoff from roads and tracks, by retaining water for ground soakage, and also to trap sediment on-site.

Figure 6 Soakhole

4.4.3 Application

Soak holes are used in the following situations;

- On the lower boundary of landings.
- Draining from water tables on the edge of roads and tracks.
- On free draining soils such as pumice or non-cohesive ash.
- In natural ground, as long as slopes are not too steep.
- As permanent or temporary drainage controls.
- In conjunction with water bars/cutoffs.

4.4.4 Design/Construction Specifications

The following points cover the design criteria for soak holes:

- Excavate to at least 1 metre in depth.
- Soakholes are normally constructed to the width of the excavator bucket used for the operation.
- Always install soakholes in natural ground, and never in disturbed soil.
- Do not install soakholes where there is a potential for the slope above them to collapse into the soakhole.
- The slope of the inlet into the soakhole should be reasonably flat to avoid erosion problems.
- Do not place soakholes on blind areas of road, where they may be a safety hazard for vehicles.
- Generally, soakholes are located to suit the terrain. However, the following spacings can be used as a guide:

Slope of Site	Spacing of Soakholes
Less than 12% slope	40 m
Greater than 12% slope	30 m down to 10 m

4.4.5 Comments

Soakholes require regular maintenance to maintain storage volume, and to prevent the floor of the soakhole from sealing with the settlement of fine material over time. If maintenance cannot be carried out regularly, maximise the size of the soakhole, and check to ensure there is a stable outlet if the hole becomes full.

4.4.6 Maintenance

Regular maintenance is required to remove any build up of sediment.

- Check soakholes during prolonged rainfall and after heavy rainstorm events, to ensure that the storage volume is adequate.
- During heavy rainfall, check that spacing of soakholes is appropriate to control the stormwater runoff.
- Check that fine material is not sealing the floor of the soakhole.
- Check that the inlet is not being scoured out with stormwater runoff.
- When cleaning out soakholes, place the excavated sediment in a safe location where it cannot wash back into the soakhole.

4.5 Hydroseeding

4.5.1 Definition

The application of seed, fertiliser, and paper or wood pulp, in the form of a slurry, sprayed over the area to be rapidly revegetated.

4.5.2 Purpose

To establish vegetation quickly, and in a range of sites, while providing a degree of instant protection from rain drop impact.

Figure 7 Hydroseeding

4.5.3 Application

This practice applies to any site where vegetation establishment is important for the protection of exposed ground. For example:

- Critical areas at an earthwork site, such as steep slopes or batters and exposed areas near watercourses that may erode.
- Critical areas that are difficult to establish by conventional sowing methods.
- Protection of critical bare areas where seasonal timing is not ideal for conventional sowing methods.
- Around watercourses, or on runoff diversion channels/bunds, where rapid establishment of a protective vegetation cover is required before introducing flows.

4.5.4 Design/Construction Specifications

The seed generally adheres to the pulp, which improves the microclimate for germination and establishment. This method allows vegetation to establish on difficult sites and can extend into cooler winter months, especially if it is utilised with mulching.

- *Site Preparation*: Before hydroseeding, install any necessary erosion and sediment control practices to control stormwater runoff.
- *Moisture Content of site*: Hydroseeding requires moisture for germination and growth. Because hydroseeding is often used for difficult sites, the timing of the application to get favourable growing conditions is an important factor. Check that steep pumice slopes are not so dry that they will crumble as the hydroseeding is applied.

4.5.5 Comments

Always use local knowledge, and experienced contractors to ensure that the seed mix is appropriate for the site.

4.5.6 Maintenance

Heavy rainfall can wash hydroseeding away, particularly from smoother hard surfaces and overland flow paths. Where vegetation establishment is unsatisfactory, the area will require hydroseeding again. Protect all revegetated areas from traffic flows and other activities that may disturb the hydroseeded surface.

4.6 Mulching/Bark/Logging Residue

4.6.1 Definition

The application of mulch, (hay or straw) bark, wood residue/wood pulp, spread over the surface of disturbed ground, in an even layer.

4.6.2 Purpose

To provide an instantaneous layer of protection, in the form of a mulch, over the ground surface, to prevent scouring from the erosive forces of raindrop impact and overland flow.

Figure 8 Mulching

4.6.3 Application

This practice applies to any site where vegetation establishment is important for the protection of exposed ground.

Mulching can be used at any time where instant protection of the soil surface is desirable. Mulching can be used in conjunction with seeding to establish vegetation, or by itself to provide temporary protection of the soil surface.

Mulching is particularly useful when climatic conditions or seasonal effects are not ideal for vegetation establishment.

4.6.4 Design/Construction Specifications

Prior to application of mulch, ensure that the site has adequate erosion and sediment control to ensure that overland flow is not concentrated.

Ensure that the mulch material is free of any plant pest material as identified in the Environment B·O·P document *Plant Pest Management Strategy for the Bay of Plenty Region, September 1998*.

Mulching needs to be spread uniformly, and secured to the soil surface, if the weight of the mulch is not suitably heavy. For smaller areas, hand spreading of mulch is satisfactory. However, for larger areas, mulch should be applied mechanically, to ensure an even spread of material. Anchoring of the mulch can be accomplished using a tackifier (such as hydro seeding), or crimping the material with discs.

Within the forestry situation, wood products suitable for mulching, such as bark or wood chips, are more likely to be available. The high cost of hydroseeding and applying straw mulch will normally mean that it is used on critical sites only. If straw or hay mulch is used, it should be applied so that a good surface cover is achieved.

4.7 Geosynthetic Erosion Control Systems (GECS)

4.7.1 Definition

The artificial protection of channels and erodible slopes utilising artificial erosion control material such as geosynthetic matting, geotextiles or erosion matting.

4.7.2 Purpose

To immediately reduce the erosion potential of disturbed areas and/or to reduce or eliminate erosion on critical sites during the period required to establish protective vegetation. Some forms of artificial protection may also assist in vegetation establishment.

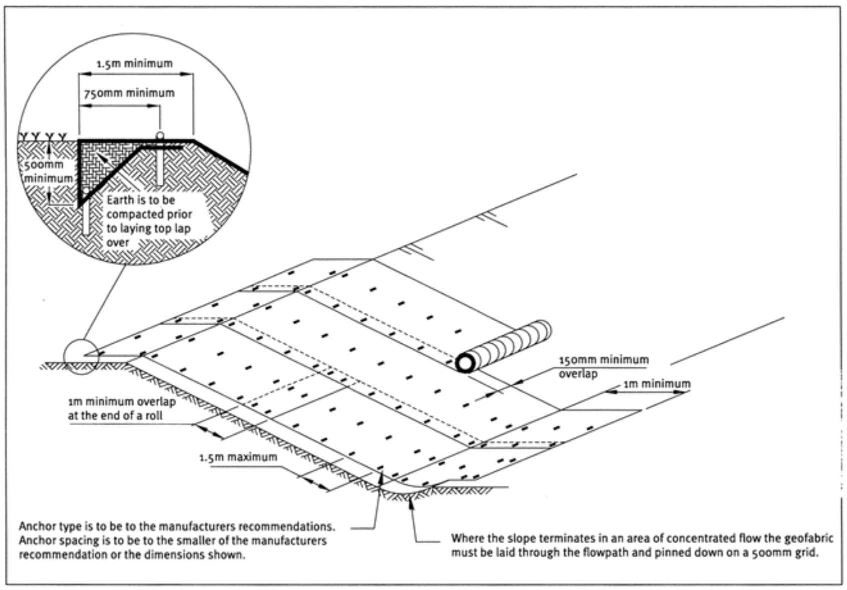


Figure 9 Geotextile Laid On Slope

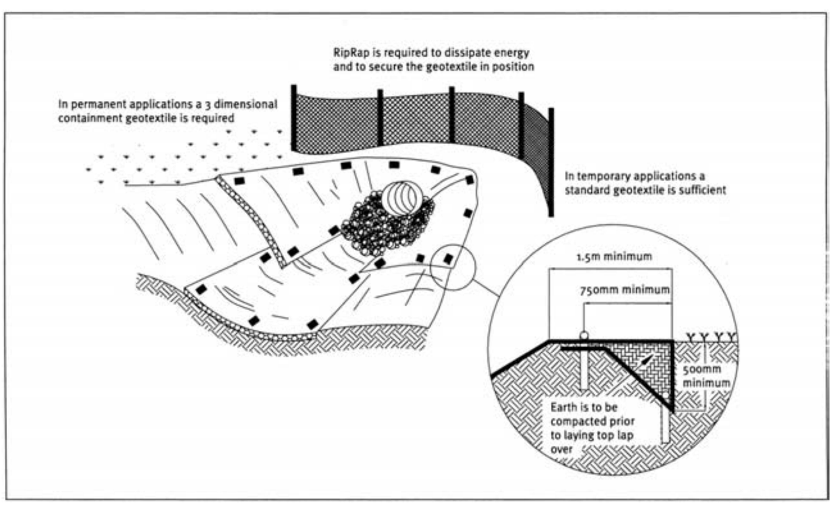


Figure 10 Geotextile Culvert Outlet

4.7.3 Application

GECS may be used in the following situations:

- In critical erosion-prone areas such as sediment retention pond outlets and inlet points
- In channels (both perennial and ephemeral) where the design flow produces tractive shear forces greater than existing soils can withstand
- In areas where there is not enough room to install adequate sediment controls
- In areas that may be slow to establish an adequate permanent vegetative cover
- On short steep slopes
- On areas that have highly erodible soils
- In situations where tensile and shear strength characteristics of conventional mulches limit their effectiveness in high runoff velocities
- In areas where the downstream environment is of high value and rapid stabilisation is needed

4.7.4 Design/Construction Specifications

There are two categories of GECS; temporary degradable and permanent non-degradable.

(a) Temporary Degradable GECS

These are used to prevent loss of seedbed and to promote vegetation establishment where vegetation alone will be sufficient for site protection, once established. Common temporary GECS are erosion control blankets, open weave meshes/matting, and organic erosion control netting (fibre mats factory-bonded to synthetic netting).

(b) Permanent Non-Degradable GECS

These are used to extend the erosion control limits of vegetation, soil, rock, or other materials. Common permanent GECS are three-dimensional erosion control and revegetation mats, geocellular confinement systems, reno mattresses and gabions.

The selection of an appropriate GECS is a complex balancing of the relative importance of the following requirements.

- *Endurance:* durability, degree of resistance to deformation over time, ultra violet radiation, and chemicals (natural chemicals and contaminants).
- *Physical:* thickness, weight, specific gravity and degree of light penetration. Generally, a thicker, heavier material will provide better protection.

- *Hydraulic:* ability of the system to resist tractive shear strength and protect against channel erosion, erosion of underlying soils, or slope erosion from rainfall impact.

- *Mechanical:* deformation and strength behaviour. Tensile strength and elongation, stiffness (how well it will conform to the subgrade), and how well it will resist tractive shear forces.

When a geotextile is to be used for temporary channel or spillway protection, consider combining a high strength low permeability cloth over a soft pliable needle punch cloth pinned to ensure the cloth is in contact with the entire soil surface. Trench and pin all flow entry points such that the upslope geotextile edge overlaps the downslope geotextile mat. Toe in the upslope end of the downslope mat.

In high risk areas such as spillways and diversions, pin geotxtiles down on a 0.5 m grid or in accordance with the manufacturers specifications, whichever provides the greatest number of contact points.

There is a large number of products available for all situations and depending on the degree of protection needed, a product, or combination of products will be available to suit most situations. It is vital that the product utilised, is designed for the intended use, and installed and maintained according to its specifications. Decision analysis techniques ranking the various GECS available should be used based on the following categories.

- Sediment yield (generally ranked highest)
- Stability under flow
- Vegetation enhancement
- Durability
- Cost

When installing GECS within a channel, it is important that the design velocity of the product is considered and again that the product chosen, is appropriate for the intended use.

Many products provide for the combination of a revegetation technique and an artificial erosion control measure. Again, design specifications need to be closely followed in all cases.

4.7.5 Comments

There is little information available to provide comparison between different products, and no industry standards that can be used to validate comparable products. Sometimes, a particular product is specified, without the necessary design parameters that are required. Obtaining valid price comparisons with similar products may be difficult.

4.7.6 Maintenance

Inspect after every rainfall, and undertake maintenance immediately.

4.8 Sediment Retention Fencing (Silt Fences)

4.8.1 Definition

A temporary barrier of woven geotextile fabric used to intercept runoff, reduce its velocity and impound sediment laden runoff from small areas of disturbed soil. Commonly called silt fences.

4.8.2 Purpose

To detain flows from runoff so that deposition of transported sediment can occur through settlement. Silt fences can only be used to intercept sheet flow. Do not use them as velocity checks in channels or place them where they will intercept concentrated flow.

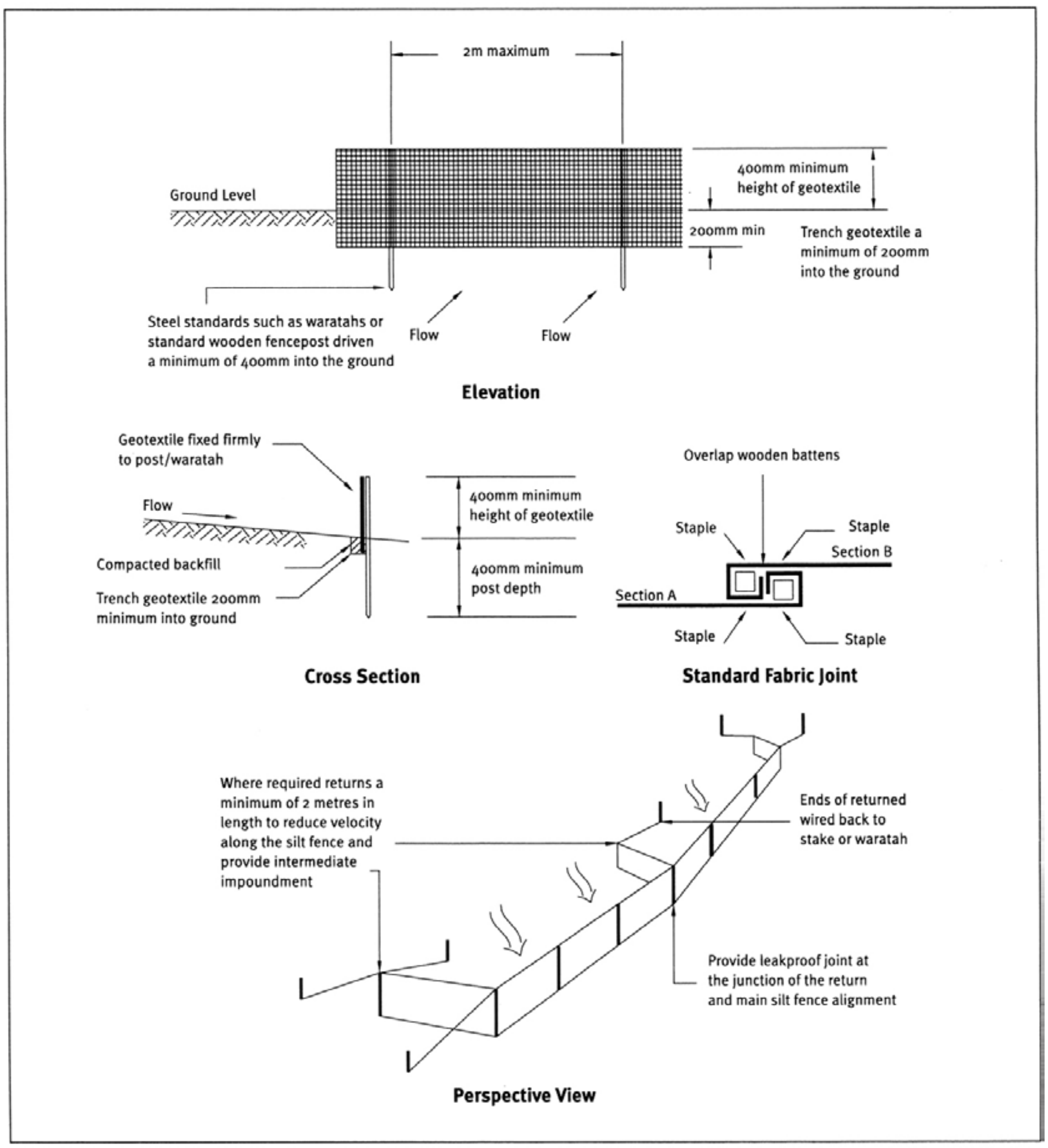


Figure 11 Sediment Retention Fencing (Silt Fence)

4.8.3 Application

Silt fences may be used in the following situations.

- On low gradient sites or for confined areas where the contributing catchment is small, such as short steep batter fills and around water courses.
- To delineate the limit of disturbance on an earthworks site such as riparian areas or bush reserves.
- To store runoff behind the Silt Fence without damaging the fence or the submerged area behind the fence.
- Do not install sediment fences across watercourses or in concentrated flows.

4.8.4 Design/Construction Specifications

Design

- Ensure silt fence is a minimum of 400mm above ground level.
- Place supporting posts/warratahs for silt fences no more than 2m apart unless additional support is provided by tensioned wire (2.5mmHT) along the top of the sediment fence. Where a strong woven fabric is used in conjunction with a wire support, the distance between posts can be extended up to 4m. Double the silt fence fabric over, and fasten to the wire and posts with wire ties or cloth fastening clips at 150mm spacings. Ensure supporting posts/warratahs are embedded a minimum of 400mm into the ground.
- Always install silt fences along the contour. Where this is not possible, or where there are long sections of silt fence, install short sediment Fence returns projecting upslope from the silt fence to minimise concentration of flows. Silt fence returns are a minimum of 2m in length, can incorporate a tie-back, and are generally constructed by continuing the Sediment fence around the return and doubling back, eliminating joins.
- Join lengths of silt fence by doubling over fabric ends around a wooden post or batten or by stapling the fabric ends to a batten and butting the battens together.
- Maximum slope lengths, spacing of returns and angles for silt fence are shown in table below.
- Install sediment fence wings at either end of the silt fence projecting upslope to a sufficient height to prevent outflanking.
- Where impounded flow may overtop the silt fence, crossing natural depressions or at low points, make provision for a rip-rap splash pad or other outlet protection device.
- Use of silt fence in catchments greater than 0.5 ha requires careful consideration of specific site measures. Other control measures may be better such as the Super Sediment Retention Fence.

- Where water may pond behind the silt fence, provide extra support for the silt fence with tie-backs from the silt fence to a central stable point on the upward side. Extra support can also be provided by stringing wire between support stakes and connecting the filter fabric to this wire.

- The fabric cloth must meet the following requirements for Geotextile fabric:

  Tension Strength: 0.345 pa (minimum)
  Tensile Modulus: 0.140pa (minimum)
  Apparent Opening Size: 100µm

4.8.5 Sediment Fence (Silt Fence) Design Criteria

Slope Steepness %	**Maximum Slope Length (m)**	**Spacing of returns (m)**	**Maximum Sediment Fence Length (m)**
Flatter than 2%	Unlimited	N/A	Unlimited
2-10%	40	60	300
10-20%	30	50	230
20-33%	20	40	150
33-50%	15	30	75
Over 50%	6	20	40

4.8.6 Construction Specifications

- Use silt fence material appropriate to the site conditions and in accordance with the manufacturer's specifications.

- Excavate a trench a minimum of 100mm wide and 200mm deep along the proposed line of the silt fence. Install the support posts on the downslope edge of the trench and silt fence fabric on the upslope side of the support posts to the full depth of the trench, then backfill the trench with compacted fill.

- Use supporting posts of tanalised timber a minimum of 50mm square, or steel warratahs at least 1.5m in length.

- Reinforce the top of the silt fence fabric with a wire support made of galvanised wire of a minimum diameter of 2.5mm. Tension the wire using permanent wire strainers attached to angled warratahs at the end of the silt fence.

- Where ends of silt fence fabric come together, ensure they are overlapped, folded and stapled to prevent sediment bypass.

4.8.7 Comments

Use silt fences rather than hay bales, if you have a choice of the two. Always be vigilant when checking the effectiveness of the silt fence; it is only as strong as its weakest point.

4.8.8 Maintenance

- Inspect silt fence at least once a week and after each rainfall. Make any necessary repairs when bulges occur or when sediment accumulation reaches 50% of the fabric height.

- Any areas of collapse, decomposition, or ineffectiveness need to be immediately replaced. Do not remove old fence, build a replacement fence immediately upslope.

- Remove sediment deposits as necessary to continue to allow for adequate sediment storage and reduce pressure on the silt fence. Ensure that the sediment is removed to a secure area.

- Do not remove silt fence materials and sediment deposition until the catchment area has been appropriately stabilised. Stabilise the area of the removed silt fence.

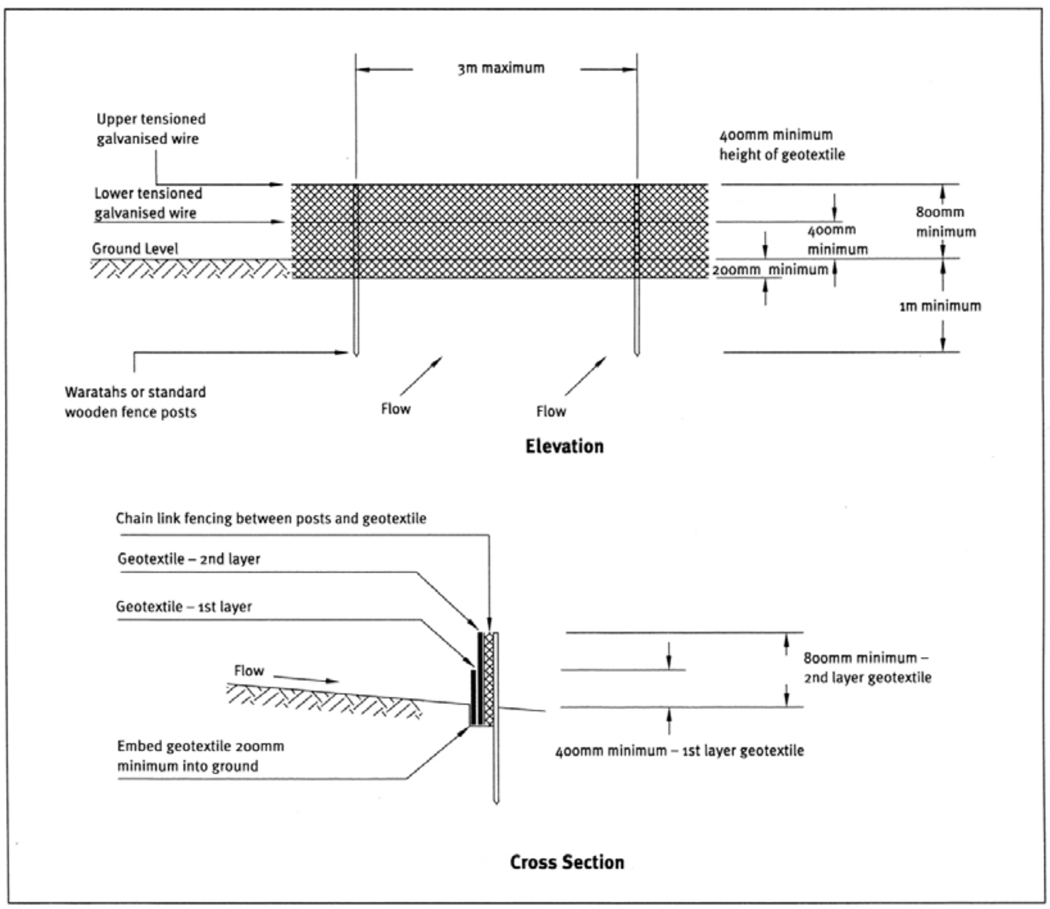


Figure 12 Super Sediment Retention Fence (Silt Fence)

4.9 Hay Bale Barrier

4.9.1 Definiton

Temporary barriers of hay bales used to intercept and direct surface runoff from small areas.

4.9.2 Purpose

To intercept or direct sediment laden runoff from small areas to a sediment retention facility so that deposition of transported sediment can occur. Hay Bale Barriers do not filter sediment.

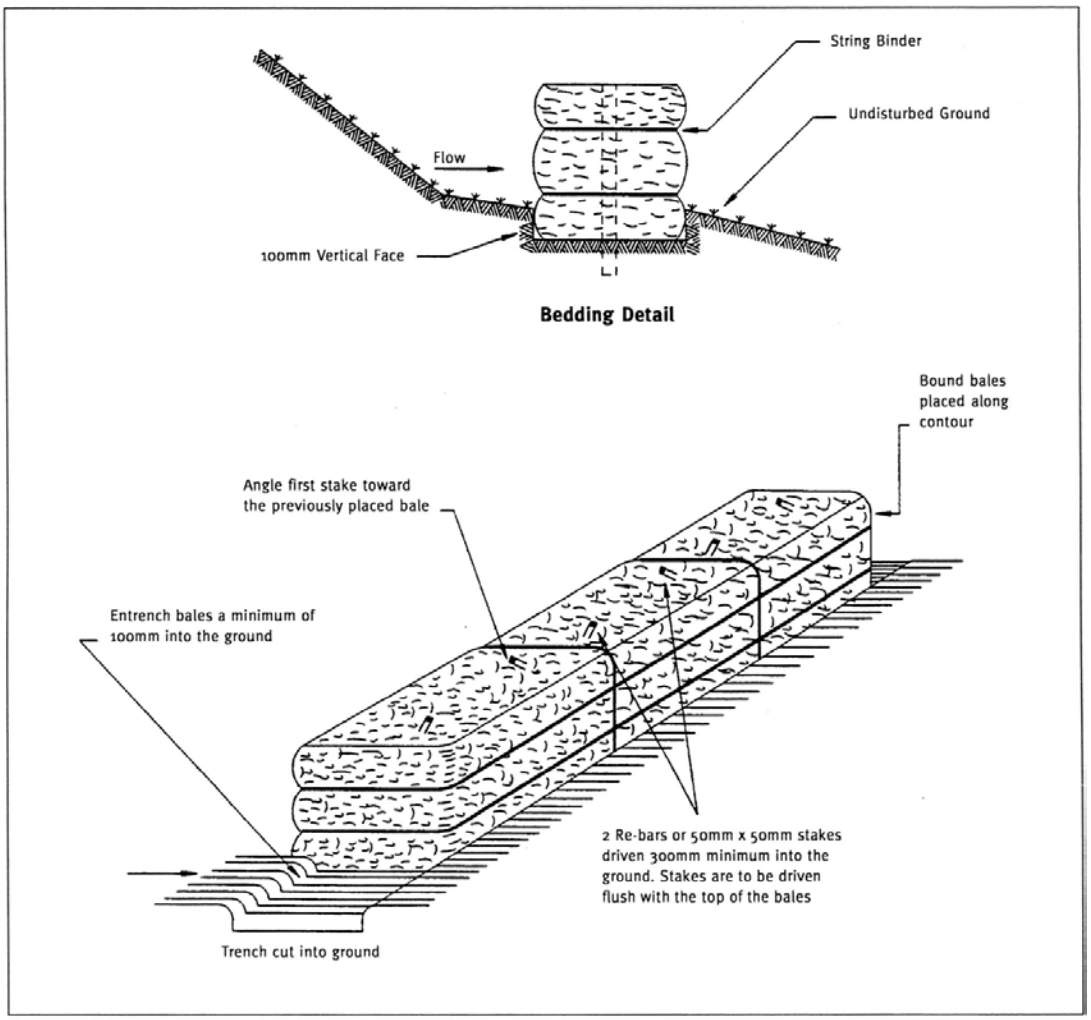


Figure 13 Hay Bale Barrier

4.9.3 Application

The practice of using Hay Bale Barriers is quite limited. In particular, they are not primary sediment control measures. Specific applications, and limitations, include the following:

- Use Hay Bale Barriers for short term needs (generally less than 1 month duration).

- Only use hay bale barriers to intercept sheet flow, and not channelled flow. In particular, do not use them as velocity checks in channels, or place them where they will intercept any concentrated runoff flow. Because they do not act as filters, they can be easily overtopped, or scoured out.

- Do not use with a catchment area of more than 0.2ha, per 100m length of bales.

- Do not use Hay Bale Barriers on slopes exceeding 20% as the risk of concentrated flow is too great.

4.9.4 Design/Construction Specifications

The following construction specifications should be followed:

- Place Hay Bale Barriers along the contour with bales in a row with the ends tightly abutting adjacent bales.

- Dig each bale into the ground 100mm and place so the bale bindings are horizontal.

- Do not place bales more than 1 bale high.

- Secure bales in place by 2 stakes driven through the bale 300 to 400mm into the ground. Drive the first stake towards the previously laid bale at an angle to force the bales together. Drive stakes flush to the top of the bale.

4.9.5 Comments

Hay Bale Barriers are used far more often than they should be used. This is because they are incorrectly seen as being a sediment treatment device. In fact they can divert and detain stormwater runoff. Hay Bale Barriers are used most successfully where they are constructed to divert runoff from small catchment areas to treatment devices or stable areas.

4.9.6 Maintenance

Inspect Hay Bale Barriers frequently, and after each rain event. Undertake maintenance as necessary. Check to ensure that the catchment area draining into the Hay Bale Barriers is not too great.

Remove all bales when the site has been fully stabilised. Stabilise the trench where the bales were located and grade so the ground level is flush.

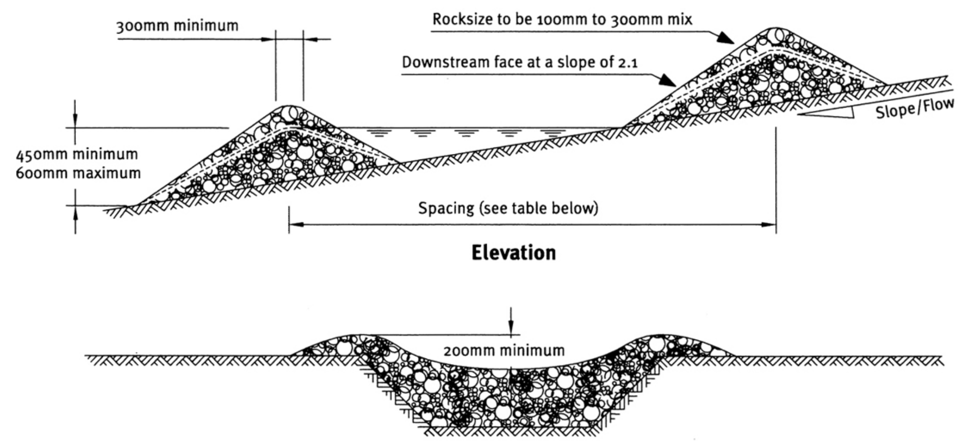
4.10 Rock Check Dam

4.10.1 Definiton

Small temporary or semi-permanent dam constructed across a stormwater channel or roadside water table, in series, to reduce flow velocity. May also help to retain sediment.

4.10.2 Purpose

To reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the stormwater channel. Although check dams may trap some sediment, they are not designed to be utilised as a sediment retention measure.



Standard Rock Check Dam Design

Slope	Spacing (m) Between Dams (450mm centre height)	Spacing (m) Between Dams (600mm centre height)
2% or less	24	30
2% to 4%	12	15
4% to 7%	8	11
7% to 10%	5	6
over 10%	Use Stabilised Channel	Use Stabilised Channel

Figure 14 Rock Check Dam

4.10.3 Application

This practice applies to earthworks sites where it is necessary to slow the velocity of water in temporary stormwater channels in order to prevent erosion. They may also be used in roadside water tables for the same purpose. Do not use Rock Check Dams in permanent watercourses. Specific applications include the following:

- Temporary channels, which, because of their short length of service, are not suitable for non-erodible lining, but still need some protection to reduce erosion.

- Permanent stormwater runoff channels which for some reason cannot receive a permanent non-erodible lining for an extended period of time.

- Temporary or permanent stormwater runoff channels which need protection during the establishment of a vegetation cover.

4.10.4 Design/Construction Specifications

The following design considerations should be followed:

- Ensure the contributing catchment is less than 1 hectare in area.
- Direct all flows over the centre of the Rock Check Dam.
- Construct each Rock Check Dam with a maximum centre height of 600mm. Build the sides 200mm higher than the centre to direct flows to the centre.
- Do not use Rock Check Dams as a primary sediment trapping facility. Ensure that any sediment laden runoff passes through a sediment trapping device before being discharged off the site.
- Graded rock (50mm to 100mm) may be used in the core of the Rock Check Dam, but a mix of 100mm to 300mm diameter washed rock should be used on the outside batters, and should completely cover the width of the channel.
- Ensure rock batter slopes are no steeper than 2:1.
- Locate Rock Check Dams at a spacing so that the toe of the upstream dam is equal in height elevation to the crest of the downstream dam. Ensure the toe of the upstream dam is never higher than the crest of the downstream dam.
- Supply specific design and calculations if Rock Check Dams are used on catchments greater than 1 hectare.

Slope	**Spacing (m) Between Dams**	
	450mm Centre Height	600mm Centre Height
2% or less	24	30
2% to 4%	12	15
4% to 7%	8	11
7% to 10%	5	6
Over 10%	Utilise Stabilised Channel	

4.10.5 Comments

May be used over short lengths of stormwater runoff channels, or roadside water tables, where the grade is steeper. The use of Rock Check Dams in these situations results in reduced velocities and control over potential erosion of the stormwater channel. Temporary options may also include the use of sandbags (filled with spoil from the site) rather than Rock Check Dams.

If sandbags are used, keep the centre height to 450mm maximum. The spacing between structures, and the construction design to ensure water flows over the centre of the dam, is similar to the Rock Check Dams.

4.10.6 Maintenance

While this measure is not intended to be used primarily for trapping sediment, some sediment can accumulate behind the Rock Check Dams. Remove this sediment when it has accumulated to 50% of the original height of the dam.

Check that the rock is not removed from the dams in cases of excessive velocity. Top up the rock if required, and check that the size of rock is sufficient to achieve the purpose, without being washed away.

When temporary channels are no longer needed, remove the Rock Check Dams and fill in the channel. In permanent channels, Rock Check Dams may be removed if a permanent lining is installed. In the case of grass lined ditches, the Rock Check Dams may be removed when the grass has established sufficiently to protect the channel. The area beneath the Rock Check Dam needs to be seeded and mulched or stabilised with appropriate geotextile immediately after removing the dams.

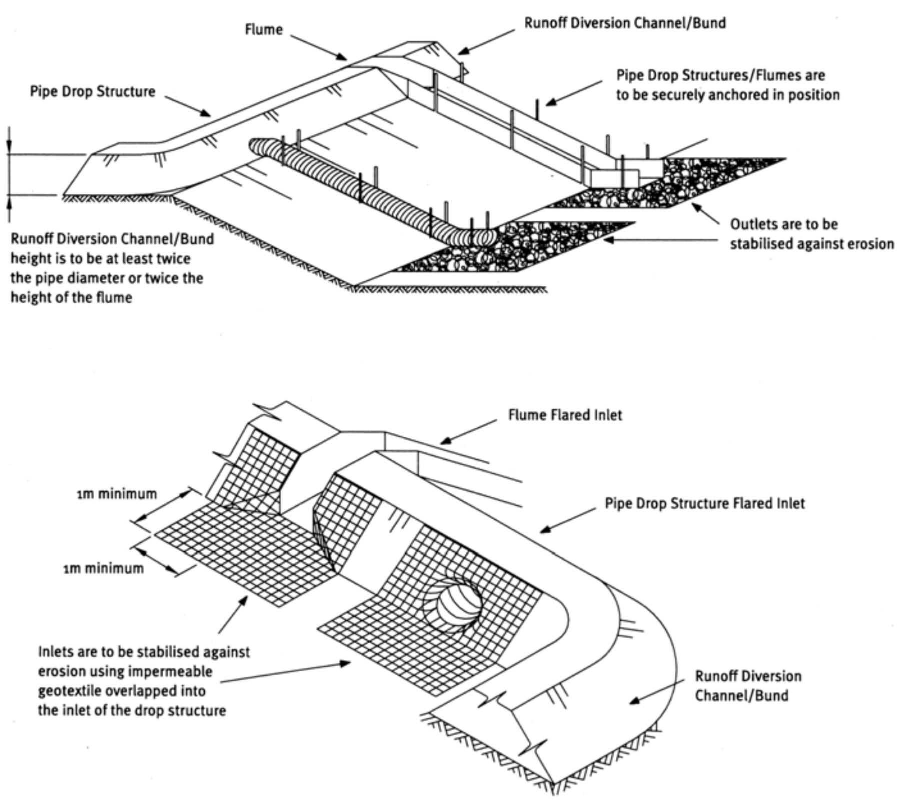
4.11 Flume/Pipe Drop Structure

4.11.1 Definition

A constructed flume or pipe structure, placed from the top of a slope to the bottom.

4.11.2 Purpose

A Flume or Pipe Drop Structure is installed to convey stormwater runoff down the face of a batter slope, to safely convey runoff from the top of the slope to the bottom, and also to prevent erosion from concentrated discharges onto the exposed slope face.



Design Criteria for Pipe Drop Structure

Pipe Diameter (mm)	Maximum Catchment Area (ha)
150	0.05
300	0.20
450	0.60
500	1.00
600	1.00

Specific designs are required for flume sizing

Figure 14 Flume Design

4.11.3 Application

Flumes or Pipe Drop Structures are used in conjunction with Runoff Diversion Channels or roadside water tables. The stormwater runoff is discharged into the Flume or Pipe Drop Structure, which conveys concentrated flows down the face of the slope. The catchment area of each Flume or Pipe Drop Structure should be limited to 1 hectare, or else specific design should be carried out to check that the capacity of the Flume or Pipe Drop Structure is sufficient to take the flow.

4.11.4 Design/Construction Specifications

The following design considerations should be followed:

- Construct all Flumes or Pipe Drop Structures of watertight materials.
- Extend the Flume or Pipe Drop Structure beyond the toe of the slope and adequately protect the outlet from erosion using rock rip-rap over a geotextile apron, or other suitable energy dissipater.
- Use the following design criteria for Pipe Drop Structures:

Pipe Diameter (mm)	Maximum Catchment Area (ha)
300	0.2
450	0.6
500	1.0
600	1.0

- Ensure that, at the Flume or Pipe Drop Structure inlet, the height of the Runoff Diversion Channel is at least twice the height of the flume or pipe diameter as measured from the invert.
- Install a flared entrance section of compacted earth. To prevent erosion, place geotextile fabric into the inlet extended a minimum of 1.0m in front of, and to the side of the inlet and up the sides of the flared entrance. Ensure this geotextile is keyed into the ground along all edges (at least 150mm).
- When the catchment area is disturbed, ensure the Flume or Pipe Drop Structure discharges into a disposal site where the sediment can be trapped.
- When the catchment area is stabilised, ensure the Flume or Pipe Drop Structure discharges on to a stabilised area at a non-erosive velocity. The point of discharge may be protected by rock rip-rap.
- Ensure that the Flume or Pipe Drop Structure has a minimum slope of 3%. If flexible pipes are used, the minimum grade should be 5%.

4.11.5 Specific Design Criteria for Flumes

The following points are specific matters that should be taken into consideration when installing Flumes:

- A common failure of flumes is outflanking of the flume entrance, or scouring of the invert to the Flume. This can be prevented by waterproofing the entrance to the Flume, by trenching using an appropriate impervious geotextile or plastic liner so that all flows are channelled into the flume. Alternatively, a piped entrance can be installed.

- Flumes can be constructed on-site from materials such as corrugated steel, construction plywood, sawn timber, or halved plastic piping.

- Construct the Flume to ensure there are no leaks. For wooden or plywood flumes, or flumes where leakage may be likely, extend an impervious liner down the entire length of the Flume structure.

- For slopes greater than 30%, a Flume can be contructed from a standard 1.2m x 2.4m x 22mm plywood sheet. This will be adequate for a catchment of up to 1 ha. Specific design is required for larger catchments.

- Fasten the flume to the slope using waratahs or wooden stakes placed in pairs down the slope at 1 to 4 metre spacings, depending on the Flume material to be used. Fasten the flume to the waratahs or stakes using wire or steel strapping.

- Place Flumes on undisturbed soil or well compacted fill.

4.11.6 Specific Design Criteria for Pipe Drop Structures

The following points are specific matters that should be taken into consideration when installing Pipe Drop Structures:

- A common cause of failure of Pipe Drop Structures is water saturating the soil at the inlet, and seeping along the pipes. Backfill properly and compact around and under the pipe with stable material in order to achieve firm contact between the pipe and the soil at all points to eliminate this type of failure. Pipe material used for the Pipe Drop Structure can consist of rigid pipe material or flexible pipe as required. If flexible pipe material is utilised, it is vital that the material is pinned to the slope in the required position to prevent twisting and potential blockages/blowouts.

- Place Pipe Drop Structures on undisturbed soil or well-compacted fill at locations chosen to minimise adverse effects if unexpected failures were to occur.

- Immediately stabilise all disturbed areas following construction.

- Secure the Pipe Drop Structure to the slope at least every 4 metres. Use no less than two anchors equally spaced along the length of the pipe.

- Ensure all pipe connections are watertight.

- Always ensure that the outlet, at the toe of the slope, is well secured.

4.11.7 Comments

Consider the weight of water that will be conveyed through the Flume or Pipe Drop Structure, and whether this will affect the stability of the structure.

4.11.8 Maintenance

- Inspect the Flume / Pipe Drop Structure regularly, and after each rainfall event that is likely to impair the function or performance of the structure.

- Ensure that the inlet is kept open at all times.

Bibliography

Auckland Regional Council Technical Publication No. 90, 1999: Erosion and Sediment Control Guidelines for Land Disturbance Activities in the Auckland Region

Environment B·O·P Guideline No. 1, Version 3, 1998: Erosion and Sediment Control Guidelines for Earthworks

New Zealand Logging Industry Research Organisation, 1993: New Zealand Forest Code of Practice

Spiers JJK, 1986: Logging Operations Guidelines published for New Zealand Logging Industry Research Association (Inc.) and the National Water and Soil Conservation Authority by the Water and Soil Directorate of Ministry of Works and Development

Glossary

Abrasion – The process of wearing down or scraping by friction. The effect of mechanical erosion of rock (especially a riverbed) by rock fragments scratching and scraping it.

Abutment – A construction that supports the end of a bridge.

Abutments – Foundations of a bridge.

Aggregate – Crushed rock or gravel screened to sizes for use in road surfaces, concrete or bituminous mixes.

Aquatic – Living or found in water

Batter – A constructed slope of uniform gradient.

Bed – *(Part 1, Section 2, Resource Management Act 1991) Means, -*

- *(a) In relation to any river –*
  - *(i) For the purpose of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the river cover at its annual fullest flow without overtopping its banks:*
  - *(ii) In all other cases, the space of land which the waters of the river cover at its fullest flow without overtopping it banks and*
- *(b) In relation to any lake, except a lake controlled by artificial means. –*
  - *(i) For the purpose of esplanade reserves, esplanade strips, and subdivision, the space of land which the waters of the lake cover at its annual highest level without exceeding its margin:*
  - *(ii) In all other cases, the space of land which the waters of the lake cover at its highest level without exceeding its margin; and*
- *(c) In relation to any lake controlled by artificial means, the space of land which the waters of the lake cover at its maximum permitted operating level; and*
- *(d) In relation to the sea, the submarine areas covered by the internal waters and the territorial sea.*

Best Practicable Option – *(Section 2, Resource Management Act 1991) in relation to a discharge of a contaminant or an emission of noise, means the best method of preventing or minimising the adverse effects on the environment having regard, among other things, to–*

- *(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and*
- *(b) The financial implications, and the effects on the environment, of that option when compared with other options; and*
- *(c) The current state of technical knowledge and the likelihood that the option can be successfully applied.*

Catchment – A geographical unit within which surface runoff is carried under gravity by a single drainage system to a common outlet or outlets. Also commonly referred to as a Watershed or Drainage Basin.

Cohesion – The capacity of a soil to resist shearing stress, exclusive of functional resistance.

Cohesive Soil – A soil that, when unconfined, has considerable strength when air-dried and significant cohesion when submerged.

Compaction – For construction work in soils, engineering compaction is any process by which the soil grains are rearranged to decrease void space and bring them into closer contact with one another, thereby increasing the weight of solid material per unit of volume, increasing their shear and bearing strength and reducing permeability

Contaminant – Includes any substance (including gases, liquids, solids and micro-organisms) or energy (excluding noise) or heat, that either by itself, or in combination with the same, similar or other substances, energy or heat:

(a) when discharged into water, changes or is likely to change the physical, chemical or biological condition of the water; or

(b) when discharged onto or into land or into air, changes or is likely to change the physical, chemical or biological condition of the land or air onto or into which it is discharged.

Deposition – The accumulation of material that has settled because of reduced velocity of the transporting agent (water or wind).

End Hauling – Removal of all excavated material off-site while road construction is being carried out. The material is normally carted back down the newly formed carriageway as the road is being constructed.

Ephemeral Watercourse – A watercourse that flows only pat of ht year; includes overland flowpaths such as grassland swales and dry gullies which only flow during more intensive rainstorms.

Erosion & Sediment Control Plan (ESCP) – A detailed plan setting out the control measures to be used to minimise erosion and off site sedimentation.

Erosion matting – A manufactured matting of either synthetic or natural fibre used to minimise surface erosion and in some cases, promote revegetation.

Flume – A high velocity, open channel for conveying water to a lower level without causing erosion. Also referred to as a chute.

Fluvial Erosion – Erosion caused by flowing water.

Friable Soils – Unconsolidated soils that are easily crumbled when worked, such sand or volcanic ash.

Gabion Basket – A flexible woven-wire basket composed of two to six rectangular cells filled with small stones. Gabions may be assembled into many types of structures such as retaining walls, channel liners, drop structures and groynes.

Geosynthetic Erosion Control Systems (GGECS) – The artificial protection of erodible channels and slopes using artificial erosion control material such as geosynthetic matting, geotextiles or erosion matting.

Geotextile Fabric – A woven or non-woven, impermeable or semi-permeable material generally made of synthetic products such as polypropylene and used in a variety of engineering, stormwater management, and erosion and sediment control applications.

Gully Erosion – The formation of predominantly steep sided erosion channels between 0.5 metres and 10 metres deep, and usually formed by water action.

Historic Site (Historic Place) –
(a) Means
  (i) Any building or structure (including part of a building or structure); or
  (ii) Any combination of land and a building structure –
  (iii) Any land (including an archaeological site); or

  That forms part of the historical and cultural heritage of New Zealand and lies within the territorial limits of New Zealand; and
(b) Includes anything that is in or fixed to such land.
(Section 2, Historic Places Act 1993)

Hydroseeding – The spraying of a slurry of seed, fertiliser and paper or wood pulp over a surface to be revegetated.

Landing (or skid) – An area where logs are brought from the stump site for sorting, processing, loading or stockpiling.

Mulch – Covering on surface of soil to protect it and enhance certain characteristics, such as protection from rain drop impact an improving germination.

Non-cohesive soils – Unconsolidated soils such as sand or volcanic ash.

Perennial Watercourse – A stream that maintains water in its channel throughout the year or maintains a series of discrete pools that provides habitats for the continuation of the aquatic ecosystem.

Reno Mattress – A shallow (300-500 mm deep), wide, flexible woven- wire basket composed of two to six rectangular cells filled with small stones. Often used at culvert inlets and outlets to dissipate energy and prevent channel erosion.

Rill Erosion – Formation of erosion channels 0.5 metres or less deep. The channels are usually formed by water action.

Rip – To break up compacted ground with heavy tines mounted on earthmoving machines.

Riparian Area – An area adjacent to a watercourse that provides a buffer between receiving environment (e.g. watercourses) and the area of operation.

Rip-Rap – Rock placed on streambanks or in stream channels to control fluvial erosion.

Runoff – That part of rainfall which is not absorbed by the ground but flows over its surface.

Scour – The erosive or digging action of flowing water; the downward or lateral erosion caused by water. Channel-forming stream scour is caused by the sweeping away of mud and silt from the outside bank of a curved channel (meander), particularly during a flood.

Sediment – Solid material, both mineral and organic, that is in suspension (suspended sediment), is being transported, or has been moved from site of origin by air, water, gravity, or ice and has come to rest on the earth's surface either above or below water.

Sediment Yield – The quantity of sediment discharged from a particular site or catchment in a given time, measure in dry weight or by volume. When erosion and sediment control measures are in place, sediment yield is the sediment discharged from the site after passing through those measures.

Shear Strength –The ability to resist shear (slip) forces.

Sheet Erosion: Erosion (often initiated by splash erosion) in which thin layers of surface material are gradually removed more or less evenly from an extensive area of sloping land.

Slash – Branches trimmed from production logs.

Splash Erosion – The erosion caused by rainfall impact which causes the initial dispersion of soil particles.

Stabilisation – Providing adequate measures, vegetative and/or structural that will protect exposed soil to prevent erosion.

Stabilised Area – An area sufficiently covered by erosion-resistant material such as a good cover of grass, or paving by asphalt, concrete or aggregate, in order to prevent erosion of the underlying soil.

Tackifer – A compound that is added to straw mulch to bind it together and prevent it being blown around by the wind.

Tensile – Resistance to elongation and tearing.

Tephra Layers – Volcanic material, such as ash, deposited from the air following an eruption.

Thinning – Felling selected trees in a stand to a prescribed pattern, for waste or extraction.

Toe (of slope) – Where the slope stops or levels out. Bottom of the slope.

Waahi Tapu – A place sacred to Maori in the traditional, spiritual, religious, ritual, or mythological sense.

Windrow – Slash, stumps, logs or debris piled in a row by machine.

Appendices

Information on consent requirements

Appendix I General information on consents

Flow diagram for Erosion Hazard Zone.

Flow diagrams for different activities;

- exotic vegetation disturbance,
- indigenous vegetation disturbance,
- roading/tracking, earthworks.

Note that these flow diagrams are a user friendly method of indicating whether a consent may be required. If in doubt, refer directly to the Land Plan or contact Environment B·O·P.

Standard Conditions for Permitted Activities from Proposed Bay of Plenty Regional Land Management Plan (March 1998).

Appendix II Example of a Forest Establishment Plan
Example of a Harvest Plan

Appendix I

GENERAL INFORMATION ON RESOURCE CONSENTS

When is a resource consent required?

(a) Land Use Consent

A land use consent is required for controlled and discretionary activities covered in the proposed Bay of Plenty Regional Land Management Plan - March 1998, referred to as the Land Plan.

There are normally threshold levels or critical situations before consents are required on activities such as vegetation clearance, tracking, roading, earthworks or burning. A series of flow charts, included in this appendix, can be used to provide a simple indication of whether the activity you propose requires a consent under the Land Plan. However, the Land Plan document itself, should be referred to, for specific details on requirements for consents. If there is any doubt, an Environmental Consents Officer from the Regional Council will be able to advise prospective applicants accordingly.

A land use consent is also required for activities such as earthworks, reclamation, and depositing, within the bed of a lake, river or stream. Stream crossings, (bridges, culverts etc), may require a land use consent. The Land Plan provides for small scale stream crossings to be permitted, subject to standards and conditions.

Any earthworks which may modify or destroy an archaeological site will require separate approval from the Historic Places Trust.

Burning operations may also require separate consents from the regional council, district council, and Department of Conservation, depending on the area and location of the proposed burning operations.

When consent applications are prepared, an Assessment of Environmental Effects is required. This requires the applicant to consider any potential or actual adverse environmental effects, including affected parties. Any works affecting native forest, or stream habitat, will generally require the written agreement of Department of Conservation, as an affected party.

(b) Other Consents or Permits

Any activity which results in discharges of stormwater containing sediment to water or onto land (e.g. quarries, construction of subdivisions etc) also requires a discharge permit. Ongoing stormwater discharges of clean stormwater may also require a discharge permit.

Discharge of particulate matter to air (dust emissions) may also require a discharge permit if they cause a nuisance off site.

Environmental Consents Officers from the Regional Council are able to advise applicants of the specific requirements for such applications.

The following charts are a guide to assist in determining whether a consent is required. If you are unsure, contact an environmental consents officer from the Regional Council.

DO I NEED A RESOURCE CONSENT?

FLOW CHART FOR IDENTIFYING EROSION HAZARD ZONE

Earthworks, vegetation clearance, and burning activities within an erosion hazard zone require a resource consent. The flow diagram below will help to identify whether the activity you propose is within an erosion hazard zone. Erosion hazard zones occur on land that has very severe limitations for use due to severe to extreme erosion hazards that make the land unsuitable for most land uses.

The predominant slope of the land is greater than 40 degrees. ⇒ Yes ⇒

No

The land drains directly to a stream or lake, and the predominant slope is greater than 35 degrees. ⇒ Yes ⇒

No

The land is on coastal sand dunes and lies within 200 metres of the mean high water spring tide line. ⇒ Yes ⇒

No

The land has an altitude of greater than 1,200 metres above sea level. ⇒ Yes ⇒

No

The land is within a dry gully system in the upper Rangitaiki River catchment above the confluence of the Otangimoana Stream, and the Rangitaiki River, including the Otamatea River. ⇒ Yes ⇒

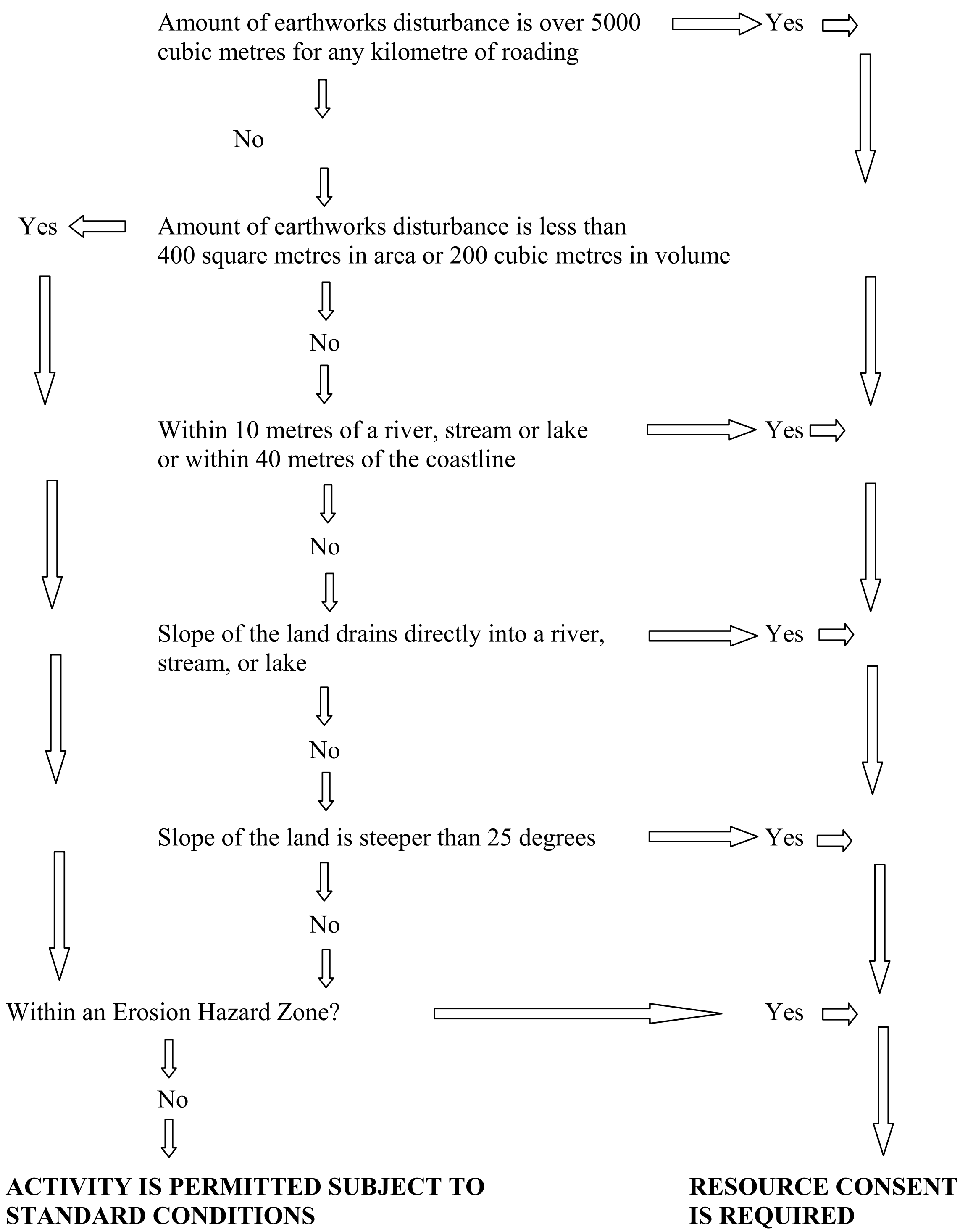
No

Not an Erosion Hazard Zone

Yes, the land is within an Erosion Hazard Zone
Resource consent is required for roading, earthworks, and vegetation clearance activities.

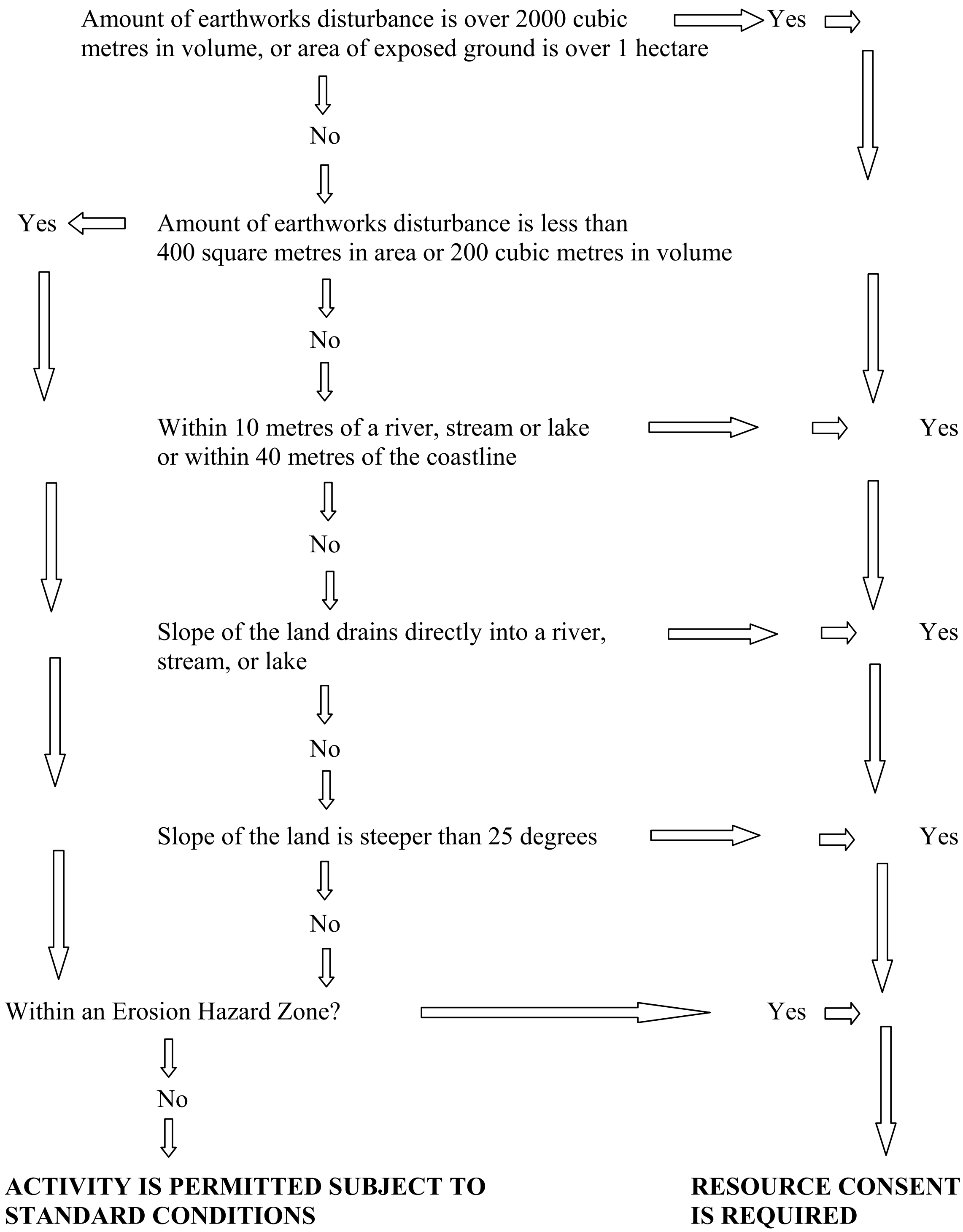
DO I NEED A RESOURCE CONSENT?

FLOW CHART FOR ROADING/TRACKING OPERATIONS



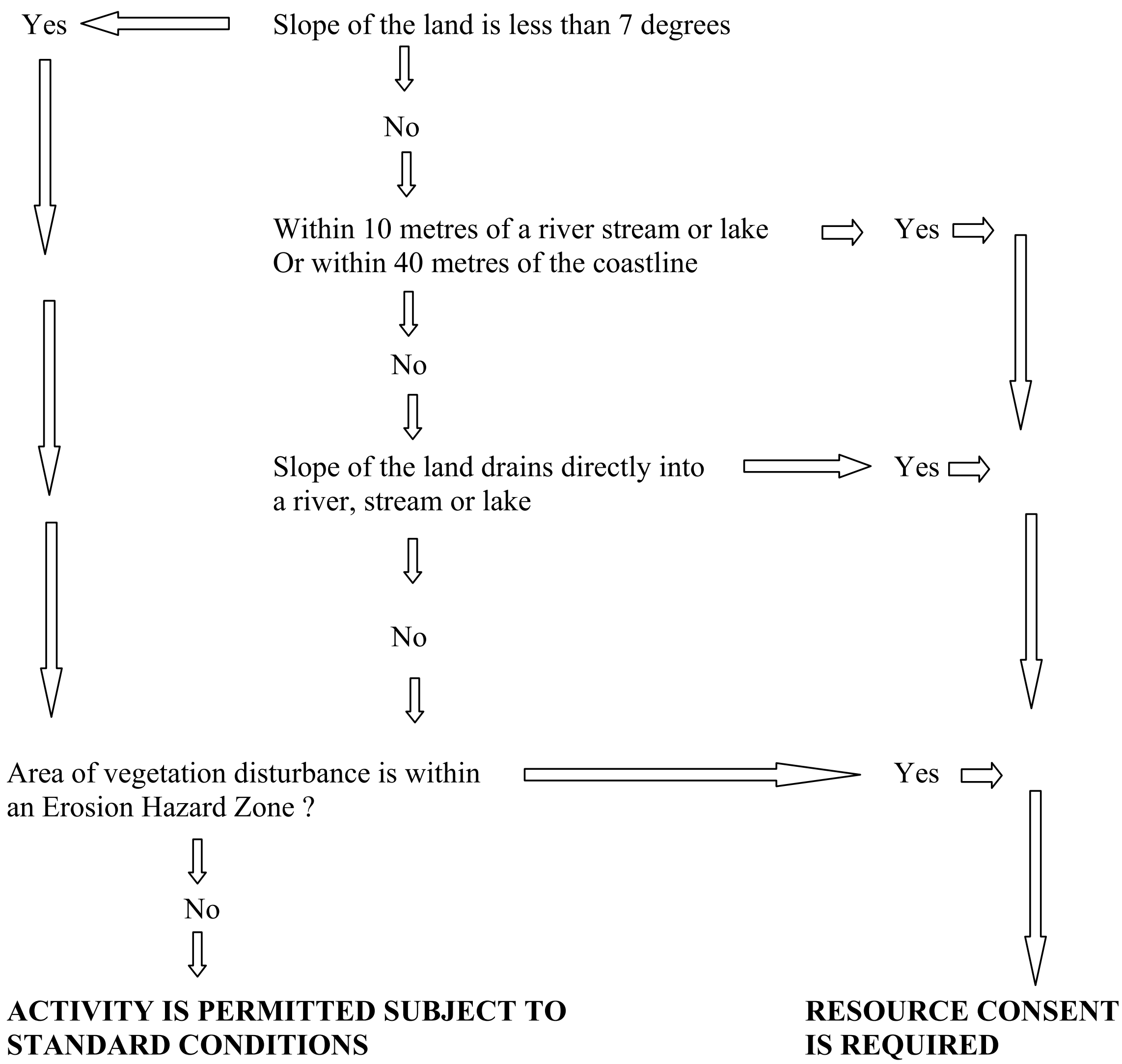
DO I NEED A RESOURCE CONSENT?

FLOW CHART FOR EARTHWORKS OPERATIONS



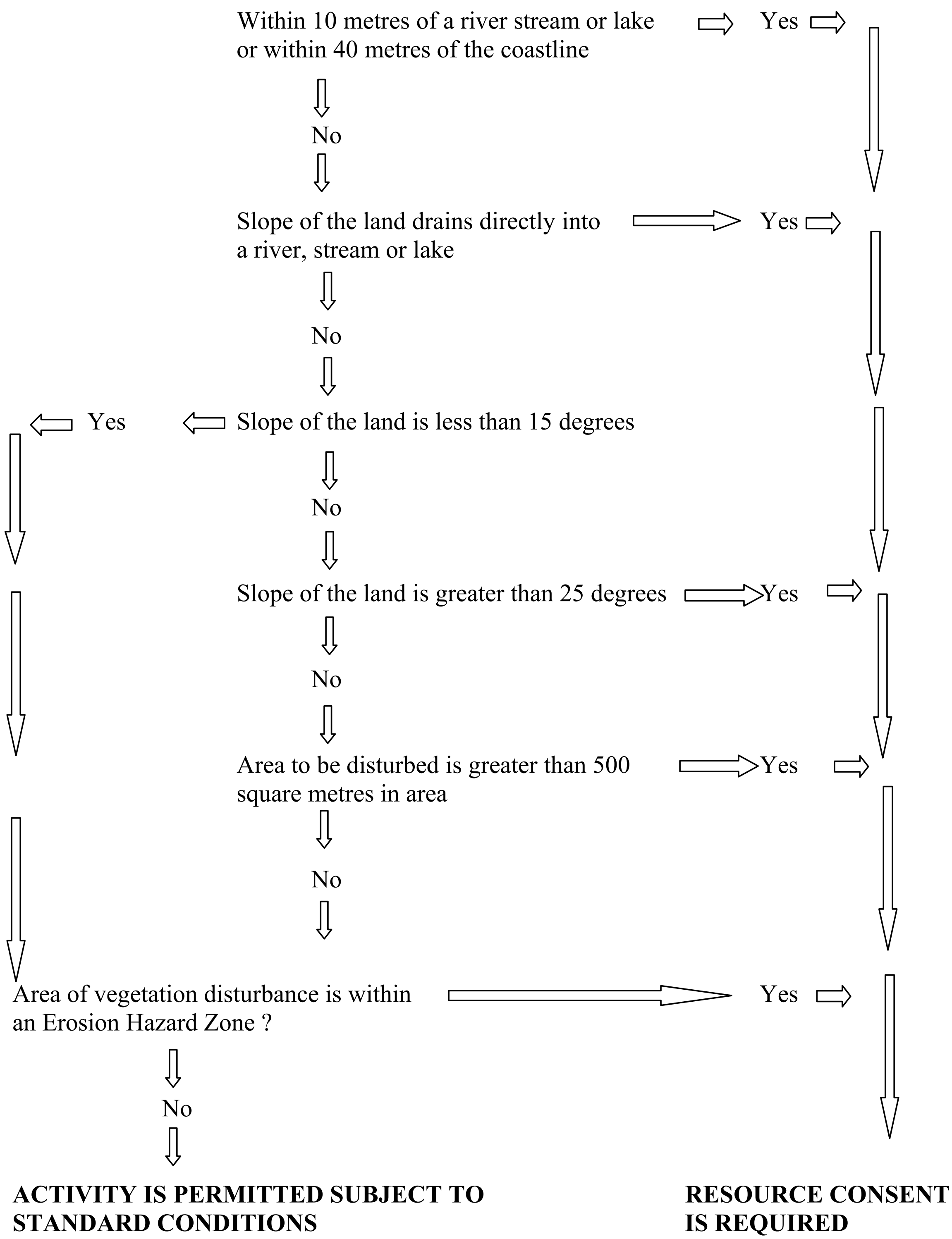
DO I NEED A RESOURCE CONSENT?

<u>FLOW CHART FOR LAND DISTURBANCE ASSOCIATED WITH EXOTIC AND PLANTATION VEGETATION DISTURBANCE/REMOVAL</u>



DO I NEED A RESOURCE CONSENT?

FLOW CHART FOR LAND DISTURBANCE ASSOCIATED WITH INDIGENOUS VEGETATION DISTURBANCE/REMOVAL



Proposed Bay of Plenty Regional Land Management Plan

Section 10.6

General Conditions, Standards and Terms for Permitted Activities

(a) The activities shall ensure the protection of any registered archaeological, historic, or waahi tapu sites.

(b) All practicable measures shall be taken to avoid vegetation, soil, slash or any other debris being deposited in a water body or placed in a position where it could readily enter or be carried into a water body.

(c) The activity shall not cause erosion or instability to the coastal environment, or the banks or beds of rivers and lakes, or wetlands.

(d) The activity shall not obstruct the free flow of water in such a manner where it results in a blockage, flooding or erosion.

(e) The activity shall not prevent existing public access to and along rivers, lakes, or the coastal marine area.

(f) Th activity shall not impede fish passage.

(g) Machinery shall not carry out land and/or vegetation disturbance activities while on the bed of a lake or a river.

(h) No machine refuelling or fuel storage shall occur where fuel can enter any water body.

(i) The activity site shall be either established in vegetation to achieve at least 80% ground cover, as soon as practicable, but no later than within six months of the activity being completed, or stabilised using other methods (e.g. mulching, compaction/drainage control, metalling, etc) as soon as practicable, but no later than two months after the activity is completed.

Note: Any modification of any registered archaeological, historic or waahi tapu site requires a resource consent which must include the consent and authorisation of the Historic Places Trust.

Appendix II

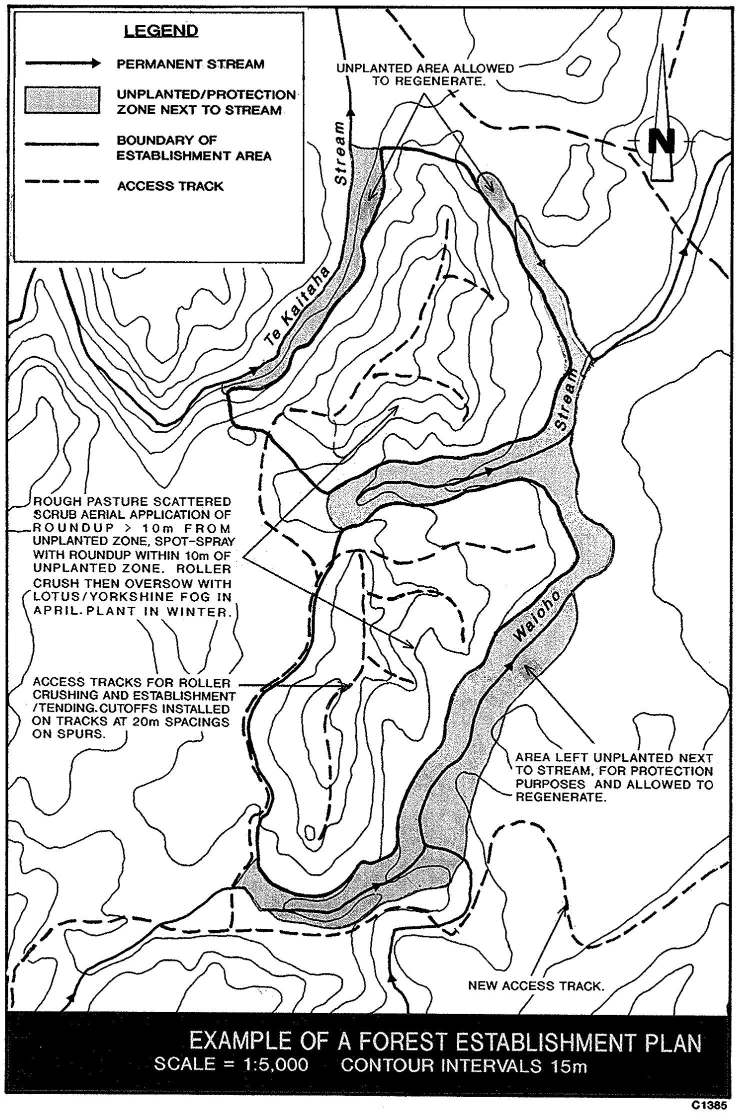


Figure 15 Example of a Forest Establishment Plan (out of scale)

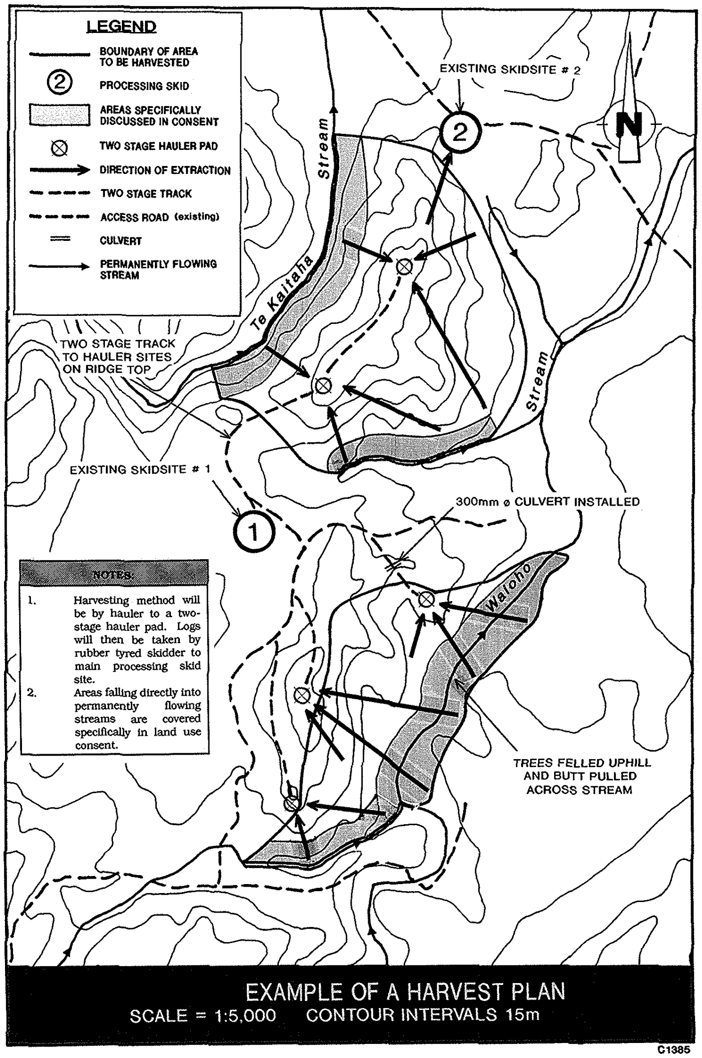


Figure 16 Example of a Harvest Plan