Environment B·O·P
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ENVIRONMENT B·O·P
Bay of Plenty Regional Council

Environmental Code of Practice for Rivers and Drainage Maintenance Activities

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Cover Photo: Lower Rangitaiki River.

Chapter 1: Introduction

This Environmental Code of Practice covers maintenance activities undertaken by the Rivers & Drainage Section of Environment B·O·P on the major river schemes and drainage control schemes in the Bay of Plenty region. The Code of Practice does not cover any new capital works programmes. The Code of Practice is divided into four main sections.

(a) **Chapters 1 to 4 cover background information** including the purpose of the Code of Practice, rivers and drainage management, and a full list of the activities covered under the Code.

(b) **Chapter 5 sets out the principles** that will be followed to avoid, remedy or mitigate adverse environmental effects.

(c) **Chapter 6 sets out the procedures** that will be used to provide for consultation, self monitoring and continual improvement.

(d) **Chapter 7 specifies the environmental guidelines** that will be followed, when rivers and drainage activities are undertaken. The environmental guidelines also include performance measures that are summarised in checklists.

The appendices provide detailed technical information that may be used as reference material if required.

The Rivers & Drainage Section of Environment B·O·P is within the Operational Services Group. The section has general responsibilities under the following legislation:

- **Land Drainage Act 1908 and the Rangitaiki Land Drainage Act 1956**
  - Management of specific drainage networks within the Bay of Plenty region;
- **Soil Conservation and Rivers Control Act 1941**
  - Implementation of river and stream works for the conservation of soil resources, prevention of erosion, and provision of flood protection;
- **Resource Management Act 1991**
  - Sustainable management of natural and physical resources (including existing flood control schemes),
  - Promotion of soil conservation,
  - Maintenance and enhancement of water quality,
  - Maintenance of water quantity,
  - Avoidance or mitigation of natural hazards (including flooding).

The Rivers & Drainage Section has specific operational responsibilities for the management of:

- Five major river and drainage control schemes.
- A number of smaller river and/or drainage schemes.
- Thirty-four pumped drainage schemes.
- Implementation of river and stream works for the conservation of soil resources, prevention of erosion, and provision of flood protection. (These operations are not specifically addressed in this Code of Practice, as they are covered under separate resource consent provisions).

Chapter 2: Purpose of Environmental Code of Practice

The purpose of the Environmental Code of Practice is to set out operational procedures that will apply to all maintenance activities on major rivers and drainage schemes, regardless of whether an activity requires a consent or not. In addition, the Code sets out the procedures (consultation, notification, monitoring, review, improvement and audit), that will apply for all maintenance works, unless there is a conflict with any specific consent conditions.

Specific objectives of the Code of Practice include the following:

- To list and describe the operational activities carried out by the Rivers & Drainage Section of Environment B·O·P.
- To review the activities relating to maintenance works to ensure that they are achieving their desired purpose (flood protection, water level control, erosion control, drainage control).
- To identify the principles that will be followed to avoid remedy or mitigate adverse environmental effects.
- To outline the procedure for consultation/notification, monitoring and review of all maintenance works for major rivers and drainage schemes.
- To develop environmental guidelines that provide clear standards of practice for all maintenance activities, to achieve the widest practicable range of environmental benefits.
- To produce forms that may be used in the following circumstances:
  - On completion of works, to check that the operations comply with performance standards, for self monitoring purposes.
  - For notifying specific parties that works are due to commence.

Chapter 3: Rivers and Drainage Management

3.1 The Bay of Plenty Region

The Bay of Plenty region stretches from Waihi Beach in the west, across to Cape Runaway in the east. Most of the catchment area draining into the Bay of Plenty between these two points is within the Bay of Plenty region. The region drains the following major areas:

- The eastern catchments of the Kaimai Range
- The northern part of the Mamaku Plateau
- Most of the Rotorua lakes, including the coastal hill country between the Tauranga Harbour and the Rangitaiki Plains
- The Rangitaiki Plateau and Urewera Range
- The eastern Bay of Plenty hill country draining the Huiarau and Raukumara Ranges

The geology of the region can be broken up into two main sections. The western Bay of Plenty is largely volcanic in origin, and is formed from part of the Taupo Volcanic Zone. The eastern Bay of Plenty has a geology that is largely sedimentary, with the ranges being formed from greywacke rock.

The geology has had a major influence on landform and topography. The western Bay of Plenty is characterised by volcanic landforms such as plateaux, calderas, lakes, and hard volcanic rocks forming domes or ranges. The eastern Bay of Plenty is dominated by steep hill country of the Urewera, Huiarau and Raukumara Ranges.

The change from steep gradients to flatter grades as the streams reach the foothills have often resulted in fan deposits of material ranging from rocks and boulders to gravels. Volcanic tephra deposits cover the whole of the Bay of Plenty, and have also been washed down the rivers to form alluvial flood plains. The flood plains tend to be formed from finer material such as sands and silts. The greywacke rock of the eastern hills is generally stable, although a combination of tectonic forces/faulting and river action has resulted in rocks and gravels being carried down the watercourses. Streams and rivers from the eastern ranges tend to carry a greater bedload of water sorted gravels, compared to streams in the western Bay of Plenty.

The climate of the Bay of Plenty is influenced by the exposure of the region to the north, and the range of topography from coastal lowlands to higher altitudes inland.

The region is largely sheltered from New Zealand's prevailing westerly winds. The climate is mild, and the rainfall relatively evenly spread throughout the year, although winters tend to be wetter than the other seasons. However, the region can be subjected to high intensity cyclonic rainstorms from the north and north-east. Annual rainfalls follow topography, ranging from 1400mm near the coast to 4000mm on the highest parts of the Raukumara Ranges.

3.2 River Processes

Rivers have a natural tendency to meander and change course across flood plains in response to processes such as bed aggradation and bank erosion. Landowners on the flood plains want to limit this tendency for rivers to change their course, so that their land assets are protected.

Rivers contain the energy of flowing water, and are ultimately powered by gravity. The energy of water may also be translated as erosive power. When gradients are steep, and/or when water volumes are large, there is a lot of energy that is available to move material within stream channels. The energy of the water is dissipated by friction on the stream banks and the stream bed. If the stream channel is made up of resistant material such as hard rock, the energy will generally be transferred further downstream. The water energy is often lost through turbulence, which may then form plunge pools and riffles through scouring of the river channel. Rivers form natural meander patterns that result from the loss of water energy being expended on the river channel. A stable meander pattern will be the result of equilibrium between the energy in the flow of the water, and the dissipating forces of friction within the river system.

If the river bed or banks are not resistant to the energy of the water, they will erode. Erosion of the river banks is known as lateral erosion. While lateral erosion will dissipate the energy of the water, it results in the deposition of material directly into the river channel. This often leads to an increased bedload within the river.

Erosion of the river bed will result in down cutting. This mobilises bedload and deposits material downstream. Down cutting may also result in headward gully erosion of the channel. Headward erosion will work its way upstream until a stable plunge pool is formed. This often requires a resistant section of river bed, and may result in a stable waterfall or set of rapids. Unfortunately, severe headward gully erosion of a river or stream channel will also result in lateral erosion of the banks as the deeper channel works it's way upstream. This will, in turn, deposit more material into the river channel, and will further destabilise the river system.

The negative impacts of erosion associated with the river banks and river beds are potentially far greater than more remote forms of erosion such as soil slip or sheet erosion. This is because **channel and bank erosion contributes virtually 100% of the material directly into the river system.** Other forms of erosion that are further removed from the rivers and streams, have much smaller erosion to sediment delivery ratios, because much of the eroded material becomes trapped (as deposition) on the ground surface before it reaches the river channels.

In a natural situation, rivers and streams are affected by geological processes over time, as well as extreme climatic events. The energy in the water is dissipated through erosion processes, which results in a moving bedload that ultimately forms the fans and flood plains in the lower reaches of river systems. The meandering nature of rivers means that as energy is dissipated, the flood plain continues to change.

3.3 The Role of Vegetation in River Processes

The land cover in a catchment can have a major influence on the stability of the rivers and streams. In the Bay of Plenty, a healthy indigenous forestland cover provides the highest degree of protection for soil and water conservation values. This is because the indigenous forest in the region is made up of a multi-tiered canopy of tree, shrub and ground cover species (including forest litter). The forest cover acts as a sponge, to reduce peak flood flows and maintain high base flows in streams. In addition, the vegetation acts as a protective cover for the soils, reducing surface erosion, fluvial erosion and deeper forms of soil movement. Different vegetation will provide different degrees of protection, with sparse ground cover being the poorest form of vegetation for the protection of soil and water resources.

Riparian vegetation provides water and soil conservation benefits in terms of improving stream bank stability, and helping to buffer and dissipate the energy of the water. Water quality is improved through the interception of nutrients and other contaminants. Aquatic habitats benefit from shading (reducing water temperatures), riparian vegetation and stabilised banks.

Changes in natural vegetation have had major impacts on river and stream systems in New Zealand. In critical headwater areas, the condition of indigenous forest can affect the hydrology of rivers. Indigenous forest in good condition, (with multi-tiered canopy, and dense ground cover/litter) is better able to retain water within the forest system, than an identical forest type that is in poor condition. Therefore, indigenous forests in good condition can help reduce “flash flood” effects by reducing flood peaks in small to medium storms, and maintaining higher base flows during dry periods. Land management factors such as animal pest control within upper catchments can provide the difference between forest that is in good condition or poor condition. Where forests have a high animal pest population, the pests can deplete lower forest canopy. Other effects may include the loss of ground cover/litter, and increased exposure of bare ground.

The Bay of Plenty is fortunate in having a relatively high percentage of native vegetation still intact in the critical upper catchment headwaters and in many of the riparian river margins. However, the native land cover is often in poor condition, in terms of providing soil conservation protection, and consequent benefits to downstream water and soil resources.

The rivers and streams that flow through the fertile lowlands and flood plains are often bounded by farmland, rather than forest. The restoration of a protective margin of river and stream bank vegetation reduces lateral erosion. In addition, the provision of suitable native vegetation may also contribute to wider environmental benefits such as biodiversity, habitat, and heritage values.

3.4 Bioengineering

Bioengineering is the practice of using vegetative systems and structures to assist with the management of rivers and streams. By combining vegetative controls with river engineering principles, the energy of the flowing water can be absorbed, and/or redirected, so that erosion of the river banks and channels is less likely to occur.

Environment B·O·P has successfully used bioengineering methods for a number of years to help control the rivers and larger streams in the region. The methods cover a range of activities such as:

- Designing and building erosion control structures that have a substantial vegetative component.
- Planting/layering trees at critical locations to help control meander patterns.
- Riparian planting of trees to help stabilise river and stream banks.

Over time, these methods have been well tested. They are generally well designed, cost effective, and successful. Bioengineering allows rivers and streams to be managed so that erosion and flooding problems are controlled, without losing the benefits of a natural river system. Generally, the only alternative to bioengineering in controlling very severe river bank erosion is to use expensive rock riprap and/or gabion structures.

The key materials used for bioengineering are willows. There are two main types of willow that are used for bioengineering:

- Tree willows**;** and
- Shrub willows**.**

Tree willows are used in two different ways. Firstly, as part of a live engineering structure (such as a groyne) to control severe bank erosion. Secondly, they can be planted on river banks and layered as they grow to provide heavy vegetative protection to the river banks.

Shrub willows are planted on berms and banks of rivers where the erosion is less severe, but stabilisation of the stream bed or banks is required.

Tree willows tend to have good strong primary and secondary root systems, whereas shrub willows tend to have a dense root mass, but with finer roots. When used together, the two types of willow are able to complement each other, and provide excellent bank protection in the harsh river environment.

Willows have a number of attributes that make them ideal for use in river control.

(a) Willows will grow in a range of conditions from relatively dry sites to very wet sites, where the willow may be partially submerged in water.

(b) Willows will grow rapidly, even in relatively poor soils.

(c) Willows have excellent root binding characteristics. This is a prime requisite for the stabilisation of river margins, as the banks are often formed from non-cohesive silts sands and gravels.

(d) Willows can be propagated relatively easily. They can be planted out vegetatively from small cuttings, stakes, branches or even whole trees. This means that willows can be layered, or take root where branches touch the ground. Generally, willows that are spread by seed are not used, as they are more difficult to control.

(e) A wide range of specially selected and bred willow varieties is available, although the supply of large tree willows at the required site is often limited.

There has been some concern expressed in respect of the extensive use of willows in river management. Willows are seen by some sectors as being easily spread, and capable of becoming a plant pest downstream. The alternative option that is often put forward is to plant suitable native species. Unfortunately, the planting of native shrubs and trees is not appropriate as a **direct alternative to willows. Willows are used because they are able to successfully establish and stabilise the relatively infertile, harsh river environment. In addition, they can be propagated by vegetative means. This allows willows to be planted on site to provide protection material for the future in a cost effective manner.** With the possible exception of alders and flax in specific sites, willows are the only practical option for primary erosion control immediately adjacent to the river channel where there is active stream bank or channel erosion.

There are a number of sites in the major river schemes of the Bay of Plenty where specially bred shrub willows have been established for the specific purpose of providing plant material for river bank protection. However, the supplies of specially bred tree willows are less extensive. The most suitable tree willows recommended by plant breeders includes the *Salix matsudana x alba* clones; Adair (NZ 1143), Hiwinui (NZ 1130), and Moutere (NZ 1184). Special purpose willows that are bred for river bank protection are chosen so that they have excellent root binding characteristics. Selected cultivars are less invasive, with less likelihood of spreading, as the branches are not brittle, and the willows do not spread by seed.

Many of the tree willows available on the middle and lower reaches of the major river schemes in the Eastern Bay of Plenty are the original *S.matsudana* or else *S.fragilis* (Crack Willow). There is anecdotal evidence to suggest that *S.matsudana* is less susceptible to stock damage, and has therefore been used as much as possible. However, the limited supply of good tree willow stock often dictates what is used. There has been concern expressed for decades about the continued use of *S.fragilis* for river works, as it has a reputation for spreading easily through breakage and regrowing where it is deposited downstream. While *S.fragilis* is used in some stretches of the various river schemes, it is only used when there are no alternative options available, and when it is already present on the river margins.

Given the establishment of the willow sawfly (*Nematus oligospilus*) in the Eastern Bay of Plenty, and its apparent attraction to *S.fragilis*, it is opportune to ensure that suitable alternative tree willow planting is undertaken. Planting should concentrate on specially bred stocks (that are non-invasive and less susceptible to sawfly damage) to provide

for future sites that can be harvested and used for bioengineering. In the meantime, if *S.fragilis* is used, it will be when there is no alternative available, and when it is already present at the activity site.

A range of recommended non-invasive willow species/clones that have been specially bred for soil conservation and rivers control purposes, is included in Appendix VII.

Native vegetation may be planted outside the primary buffer of willow. Alternatively, the willows may provide a suitable microclimate for interplanting of native species that will establish in the longer term. However, successful native revegetation requires careful planning, ongoing maintenance, and relatively high costs, over a long period of time. Native planting also requires adopting the concept of successional species to achieve a stable system in the long term. Native planting will be undertaken where the following criteria can be met:

- There should be a recognised habitat or ecological benefit that requires the use of native plantings.
- There should be a reasonable chance of successful establishment of the native regime.
- There should be an on-going maintenance programme to ensure that the native planting regime is successfully maintained in the long term. This would include such matters as animal and plant pest control.

Environment B·O·P currently uses pioneer native species in conjunction with many of its river and stream plantings. Flax, in particular, is often successfully used. In addition, following successful control over the river margin immediately adjacent to the flowing channel, willow plantings provide an ideal nurse crop for interplanting of native species further inland. Planting of native species away from the immediate high-energy stream environment will help ensure their successful establishment.

Bioengineering is an important component of river control. The key species for bioengineering is the willow - there is no direct alternative that is able to achieve the same measure of control over actively eroding river systems. This is particularly pertinent when vegetative structures and groynes are used to control active river bank and channel erosion. However, there are options for other species (particularly native species) to be planted in conjunction with willow, providing the conditions are suitable for their successful establishment and their continued viability.

3.5 Stabilisation of River Banks

River banks are defined in the Resource Management Act 1991 (RMA) as part of the river bed. Activities undertaken on the beds of rivers may require resource consent under s.13 RMA. Stabilisation of river banks makes up a significant proportion of the works carried out by the Rivers & Drainage Section of Environment B·O·P. The option of doing nothing, and allowing river bank erosion to continue is generally likely to result in greater adverse effects than carrying out erosion protection works. In the longer term, the stabilisation of river banks, and associated riparian protection, is capable of

providing a wide range of environmental benefits, as long as the work is well planned and undertaken in a progressive, comprehensive manner.

3.6 Rivers & Drainage Responsibilities

The functions carried out by the Rivers & Drainage Section of Environment B·O·P include the following:

3.6.1 Flood Protection

Construction, operation, and maintenance of stopbanks, floodgates, and pump stations throughout the Bay of Plenty region, to protect assets from flooding.

3.6.2 Water Level Controls

Construction, operation and maintenance of water levels controls in some lakes and wetlands in the Bay of Plenty to maintain water levels within specific upper and lower limits.

3.6.3 Erosion Control

Control of stream bank and channel erosion within river and stream systems in the Bay of Plenty.

3.6.4 River Management

Proactive management and maintenance of river and stream systems to reduce the risk of flooding and erosion problems as well as achieve a stable natural river system.

3.6.5 Drainage Management

Control of specific drainage schemes (including pumped schemes) in the lower Kaituna River catchment, Rangitaiki Plains, Waiotahi and Opotiki areas.

Chapter 4: Operational Activities

The full range of operational activities undertaken by the Rivers & Drainage Section of Environment B·O·P is listed below. Most of the activities in the list have guidelines for good environmental practice set out in Chapter 7 of this Code of Practice. The activities that are not covered in this Code of Practice are annotated with a footnote explaining how they are addressed.

4.1 Vegetative Protection Works

- Trenched willows/anchored willows/training groynes.
- Battered banks.
- Stream bank planting.
  - willow/poplar riparian planting (protection).
  - native species riparian planting (protection).
  - exotic species riparian planting (protection/production).
- Tree maintenance – layering, lopping, clearing, removal, and trimming.

4.2 Hard Engineering Protection Works

- Rock riprap
- Gabion baskets

4.3 River Channel Maintenance Works

- De-armouring (blading/ripping/raking) and minor channel widening and diversions.
- Gravel extractions[1].
- Weed control (spraying) of banks, berm areas (floodway), and riparian buffer zones.
- Grazing of river berms[2].

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[1] Gravel extraction will be covered under Environment B·O·P's Regional River Gravel Management Plan

[2] Grazing activities are covered under legal lease agreements

4.4 Drainage Management

- Weed controls of drains (spraying) ground based and boat, where there is no discharge to water.
- Weed control of drains (spraying) where there is a discharge to water*.
- Desilting of drains using ground based machinery.
- Salt water flushing .

4.5 Flood Protection Works

- Floodgate construction*
- Floodgate maintenance**
- Pump station construction*
- Pump station maintenance**
- Stopbank construction*
- Stopbank maintenance**

* These activities do not have Environmental Guidelines prepared for them as they are covered by a separate resource consent.

** Maintenance of stopbanks and floodgates are set out in Asset Management Plans. Activities such as discharge to water, stopbank, floodgate and pump station construction would require specificresource consent(s) from the regional and/or district council.

Chapter 5: Principles to Avoid Remedy or Mitigate Adverse Environmental Effects on Stream Beds and Water

5.1 General

The principles set out below provide general guidance on matters that should be considered when carrying out river and drainage works to avoid, remedy, or mitigate any adverse environmental effects.

Avoidance of adverse effects (as far as possible) is based primarily on isolating the site. Isolating the site also includes minimising instream works, so that discharges of sediment or contaminants into the stream bed or water are either completely avoided, or minimised as far as practicable.

The chosen methodology used for the operation (including machinery used and timing of operations), can reduce potential adverse environmental effects markedly.

Revegetation of the stream margins allows a range of measures that can be used to provide for multiple benefits, including environmental mitigation.

Maintenance of works in the long term needs to be considered at all times. All works will require some degree of maintenance. Sometimes, careful planning and increased expenditure on initial capital works may result in lower maintenance costs for the life of the works.

Staff in the Rivers & Drainage Section of Environment B·O·P, as well as contractors carrying out any work, need to be thoroughly familiar with the following principles. Their knowledge and understanding of the principles will be a major factor influencing the environmental effects of any work carried out.

5.2 Principles

5.2.1 Minimise Instream Works

Keep machinery out of water unless necessary for critical works or access. For rivers; avoid instream works during critical fish spawning and mitigation periods. For drains; minimise works in the channel during fish spawning and migration periods, for those drains that are identified as migratory pathways (see Appendix VI).

5.2.2 Avoid Discharge of Sediment into Water

When carrying out works on stream banks or on dry stream beds, plan and implement the works so that discharge of sediment into the stream channel is avoided as far as practicable. Maintain a set distance (depending on the site limitations) between the works site and stream flow, so that the likelihood of accidental discharges is minimised. Placement of rock or structures on river banks or beds should be undertaken in a manner that minimises the discharge of sediment into water. Place cleared debris and extracted material (e.g. drain cleanings) in an area where it will not affect a surface water body or impede the natural flow of water.

5.2.3 Avoid or Mitigate Effects of Activities on Fish Passage

The activity should not impede fish passage following completion of the works. If the activity is likely to result in a barrier to fish passage, then some form of mitigation should be provided.

5.2.4 Keep Disturbed Area Small, and Time of Exposure Short

Plan the works so that the extent and duration of exposed ground is minimised. Consider the seasonal differences that will affect revegetation. In the case of short-term operations in sensitive sites, check the weather forecast. Stabilise disturbed areas quickly, as soon as operations are complete. If required, revegetation can be repeated in autumn or spring. Revegetation should include ground cover as well as appropriate shrub and tree planting.

5.2.5 Isolate the Works Site to Avoid Adverse Off-Site Effects

Use diversion bunds to direct clean stormwater runoff safely away from the works site if possible. Manage the site so that stormwater runoff from the disturbed area is handled separately from runoff above the site. Use natural vegetation or sediment control devices to filter/treat any stormwater runoff if possible, prior to discharge off-site.

5.2.6 Avoid the Discharge of Contaminants onto Stream Beds or into Water

Avoid oil and fuel discharges, spillage, spray drift, etc. particularly on to stream beds or into water. Maintain machinery so that leakage from hoses and pipes are unlikely. Dispose of spray and fuel containers safely off-site.

5.2.7 Critically Assess your Operational Methodology

Always use the correct type of machinery to carry out the operation effectively, efficiently, and with minimal environmental impact. Timing of operations should take into account such matters as the nesting season for native birds, and spawning/migration seasons of fish. Consider the most appropriate time of the year to carry out work (winter earthworks may be unsuitable). Check the weather forecast daily, and alter your work programme accordingly if necessary. At the end of each day's work, leave the site with any necessary runoff controls in place, and machinery/equipment well clear of waterways.

5.2.8 Plan Riparian Planting Carefully

Use selected willow plantings as set out in Appendix VII as far as possible. Set up strategic plantings of suitably selected willow material in critical areas of river schemes to serve as a supply source for future planting material.

Only use *S.Fragilis* for heavy bioengineering work when there is no alternative available and where it is already present in vicinity of the proposed site of works.

Consider the multiple benefits of riparian planting. Ensure that livestock is excluded from all new plantings. Use locally sourced and appropriate native shrub and tree species wherever available. Ensure that any native planting has a follow up programme of maintenance to minimise long term failure.

5.2.9 Avoid Archaeological or Historic Sites

Adequate planning and consultation should be undertaken to ensure that archaeological and/or waahi tapu sites are avoided. Consultation with tangata whenua for identification of any cultural issues should follow the procedure outlined in Section 6.1.1. The procedure for protection of archaeological sites is set out in Appendix VIII.

If an unknown archaeological feature is disturbed, work should immediately cease until authorisation from the Historic Places Trust has been granted. This will normally involve consultation with tangata whenua, so the Council's Maori Policy Advisor should also be notified. Specific procedures are set out in Appendix VIII.

5.2.10 Maintain Ecological Values

Plan and implement works so that ecological values are avoided, remedied or mitigated. Consider the protection of wetlands, riparian margins, aquatic and terrestrial habitats as part of the works programme.

5.2.11 Maintain Works to an Appropriate Standard

Ensure that plantings are maintained so that animal and plant pests are controlled. Maintain plantings and hard engineering structures in good condition so that they are able to fulfil their designed function. Remove derelict structures and erosion protection works if they are likely to cause adverse environmental effect(s) or pose health and safety/navigation hazard(s).

5.2.12 Consider Emergency Contingencies

In case of flood or other emergencies while works are still underway, consider matters such as access to the site, notification of appropriate personnel, security of vehicles, gear and equipment etc.

Chapter 6: Procedure

6.1 Consultation/Notification

Staff and contractors working for the Rivers & Drainage Section of Environment B·O·P will carry out the following consultation/notification processes when undertaking operational activities, regardless of whether a resource consent is required or not.

Consultation will generally be necessary prior to a programme of works that will be ongoing for a number of weeks or months. Consultation will be undertaken with all appropriate parties beforehand. Consultation with Department of Conservation and Fish and Game New Zealand, Eastern Region (Fish and Game NZ) will be ongoing for such matters as ecological concerns and instream works. Similarly, consultation with tangata whenua will be ongoing as set out in section 6.1.1 below.

Notification will be undertaken on a weekly basis for ongoing works. It is expected that any interested parties will already be aware of the works programme. On Monday of each week, notification (as shown in Appendix II) will be e-mailed to Department of Conservation, Fish and Game NZ and Regulation and Resource Management Group of Environment B·O·P outlining the work programme for that week.

6.1.1 Consultation with Tangata Whenua

Tangata whenua issues will be addressed firstly by Council's Maori Policy Advisor, who will recommend what consultations ought to be conducted with all iwi/hapu groups who are identified as affected tangata whenua for the area of operations.

Some cases may also require notification and discussion with Council's iwi liaison committees or other local committees. These will be identified by Council's Maori Policy Advisor, who will also make the necessary arrangements.

Some Maori land blocks are also administered by Maori Land Court appointed trustees who will also be consulted as the legal owners but this does not mean that the rights of tangata whenua interests to be heard are being superseded in any way.

Reference will also be made to duly approved Iwi Resource Management Plans lodged with Council to ensure compatibility.

6.1.2 Notification to Group Manager Regulation & Resource Management, Environment B·O·P

When operating in or adjacent to water bodies, where there is a potential for adverse environmental effects on water quality.

6.1.3 Notification to Department of Conservation

- When operating in or immediately adjacent to water bodies, where there is a potential for adverse environmental effects on native fisheries, or native wildlife habitat.
- When there is a potential for adverse effects on native vegetation as a result of the proposed works.

6.1.4 Notification to Fish and Game NZ

When operating in or immediately adjacent to water bodies, where there is a potential for adverse effects on identified habitat for trout.

6.1.5 Consultation/Notification to Landowners

Landowners or occupiers will either be consulted or notified (whichever is appropriate), when works are proposed on their property or property boundary, or when access is required through their property. Neighbours will be also be contacted if there is likelihood that the works will affect them.

6.2 Self-Monitoring/Continual Improvement

A process of self-monitoring will be used to ensure that works are carried out in accordance with the Code of Practice. Self-monitoring will involve the completion of a checklist which is included as part of the Code of Practice. The foreman will be responsible for completing the checklist and this will be held on file. The checklist makes provision for improvements or comments that can be assessed as part of the annual review process. In this way, the Code of Practice will provide for a formal process of continual improvement. In addition, a database will be kept on any complaints, and corrective actions taken to address complaints. The requirement for independent audit will be assessed annually and will be undertaken as necessary, with at least one independent audit every five years. The need for independent audit will be assessed as part of the annual review process.

6.3 Review of Procedures

As part of the review process, the following will be carried out.

An annual report covering the following will be prepared:

(a) Number of complaints and corrective action(s) taken.

(b) Summary of recommended changes to procedures resulting from comments made in checklists.

(c) Analysis of types of work carried out, and any areas where complaints or problems continue to occur.

(d) Recommendation whether an independent audit is required.

(e) Listing of authorised Iwi Management Plans.

The annual report will be presented to the Operations and Rural Services Committee, at the first meeting following 31 October each year.

- An independent audit of at least 3% and up to 10% of any works carried out in a single year will be undertaken at least once in every five-year period. The audit will assess the procedures and processes that operate under the self-monitoring regime, and whether the annual reporting provisions provide adequate opportunity for continual improvement.

The independent audit will not replace the requirement for an annual report.

6.4 Registration of Works

A full register of works will be recorded and maintained.

The register of works will include, but not be restricted to:

- Type of works undertaken.
- Location of works (using Asset Management Location Plans and channel distance).
- Dates of works undertaken and completed.

Chapter 7: Environmental Guidelines

7.1 Introduction

The following environmental guidelines are set out as described in Table 1. The guidelines themselves include a brief description and purpose of the particular activity, an explanation of the relevance of the Resource Management Act 1991, a description of the potential environmental effects relating to the activity, a guideline for good environmental practice, and performance standards that can be audited.

The potential environmental effects are set out in three sections:

- The effects of not carrying out the works.
- The beneficial effects of carrying out the works; and
- The adverse effects of carrying out the works.

There may be opportunity for enhancement works to be undertaken in addition to the proposed river and drainage works. However, these will need to be considered on a case by case basis, in consultation with other parties such as Department of Conservation, tangata whenua and specialist Environment B·O·P staff. The prime reason for rivers and drainage works is to maintain the river and drainage schemes for soil conservation, flood protection and drainage management purposes. As the works are funded by rates from the scheme ratepayers, any work that provides other wider community benefits (such as enhancement for habitat purposes) should be funded in a more equitable manner.

Enhancement works will normally involve specialised riparian planting and management. In almost all cases, this will require the establishment of a native plant regime. Where it has been identified that enhancement works will **help maintain or improve identified significant indigenous habitats and ecosystems,** the enhancement works will be programmed for implementation as soon as protection works have secured the area, and adequate funding is available. In other cases where enhancement works are seen as having a potential for habitat or ecological benefit, initial consideration should be forwarded to the Manager Rivers & Drainage, who will coordinate the necessary consultation processes to ensure that the enhancement works are appropriate for the site, adequately funded, and maintained to ensure a reasonable chance of success.

In all cases where enhancement works are carried out, locally sourced native species will be planted as far as practicable. There will be times when locally sourced material is not available, and in these situations, the consultation process will determine the best course of action to be followed.

Table 1 List of Activities

Vegetative Protection Works

- Trenched willows, anchored willows, training groynes
- Battered banks
- Stream bank planting
- Tree maintenance

Hard Engineering Protection Works

- Rock riprap
- Gabion baskets

River Channel Maintenance Works

- De-armouring (blading, ripping, raking) and minor channel widening/diversion
- Weed control of river banks, floodways, and riparian buffer zones

Drainage Management

- Weed control by spraying with chemical herbicides
- Weed control by cutting weeds using weed cutter boat
- Desilting of drains using ground based machinery
- Salt water flushing

7.2 Vegetative Protection Works

7.2.1 Trenched Willows, Anchored Willows, Training Groynes

Figure 1 Bank erosion caused by floods - 1997

Figure 2 *Willows trenched and tied to anchors - 1997 (Same site as Figure 1)*

Figure 3 *Buffer zone fencing to protect native shrubs - 1997 (Same site as Figure 1)*

Figure 4 Established edge protection/buffer zone - 2000 (Same site as Figure 1)

Activity

This activity includes the use of trenched willows, anchored willows and wire and rail training groynes.

This activity involves the burying and anchoring of willow tree trunks into the river banks, with the foliage extending into the stream channel. The willows are anchored in series so that they form a continuous protective live buffer along the river bank. Training groynes may also be used, often in conjunction with the trenched/anchored willows. Follow up planting is always carried out.

Wire and rail training groynes are also included in this section on vegetative protection works because they are a short to medium term measure that ultimately relies on planting to achieve the end result. The wire and rail training groynes are often used in conjunction with the trenched/anchored willows. Follow up planting is always carried out. The training groynes are designed to encourage sediment build up behind them to allow for the successful establishment of protective plantings.

This work is generally undertaken on the banks and adjacent stream bed of rivers and larger streams.

The purpose of the works is to protect the river banks from eroding, by providing relatively heavy vegetative protection, developing strong root systems, and encouraging the deposition of sediment at the toe of the banks. Protection of the river banks results in minimising the loss of adjacent land.

Resource Management Act 1991

These works are covered under s.9 (use of land) and s.13 (structures in the bed of a river) RMA.

Potential Environmental Effects

The effects of not carrying out the works would result in the actively eroding river banks continuing to erode and deposit sediment into the river system. This would, in turn, aggravate moving bedload problems, and may also increase bank erosion downstream.

The beneficial effects of the works would be to control active lateral erosion, even on high river banks, in the medium to long term. The works are also able to provide shade and protection for other riparian planting, as well as enhancement of aquatic habitat.

Adverse effects include the potential for sediment to enter water while the works are being undertaken. There is also a potential for vegetative material to break loose in major floods, if not anchored securely.

Guidelines for Good Practice

(a) Ensure that all works are carried out in a manner that minimises the operation of machinery within the flowing river channel.

(b) Ensure that no fuel storage or machine refuelling occurs where fuel could enter a water body in the event of a spillage.

(c) Ensure that excavation and trenching operations are carried out in a manner that minimises the possibility of sediment entering the watercourse.

(d) When siting the works, consider any likelihood that the works could become a navigation hazard.

(e) Only use Crack Willow material where there is no alternative and Crack Willow is already present in the vicinity of the works site.

(f) Ensure that all material is securely anchored to prevent any material breaking free and being washed downstream.

(g) Ensure that machinery and materials are removed from the floodway at the end of each working day, to avoid the possibility of floodwater washing machinery or materials downstream.

(h) Ensure that all exposed ground is regrassed and/or effectively stabilised to control surface erosion, as soon as practicable following completion of the works.

(i) Always carry out protection planting as follow up works.

Performance Standards

- No refuelling operations or storage of fuel shall occur where spillage may result in fuel entering natural water.

- Exposed ground resulting from the works shall be regrassed or otherwise effectively stabilised as soon as practicable following completion of the works.
- Machinery shall avoid operating within the river channel as far as practicable.
- All works and material shall be securely anchored to prevent flood waters washing material downstream.
- Redundant works shall not cause a navigation hazard.
- All machinery and material shall be left in a safe site above flood level at the end of each working day or when the site is unattended.

Other Relevant References

Stream bank planting, minor channel widening, minor channel diversions.

7.2.2 Battered Banks

Figure 5 Battered bank with buffer zone/edge protection planting native flax

Activity

The purpose of this activity is to establish a sloped bank with a protective surface cover. This will reduce the potential for stream bank erosion. This activity normally involves the regrading of oversteep stream banks, and the establishment of protective ground cover and shrub vegetation. The work is undertaken on the banks of rivers and streams over the wider Bay of Plenty. The work results in a stabilised river or stream bank that is less prone to lateral erosion. The natural process of bank erosion creates small vertical “cliffs” along the stream banks. Even large well-established trees will topple if a vertical bank starts to laterally erode, as the vertical bank does not tend to stabilise itself.

Resource Management Act 1991

These works are covered under s.9 (use of land) and s.13 (structures in the bed of a river) RMA.

Potential Environmental Effects

The effects of not carrying out the works would result in any actively eroding vertical stream banks and river banks continuing to erode and deposit sediment into the river system. This will, in turn, aggravate moving bedload problems and downstream lateral erosion.

Beneficial effects of the works include reducing lateral erosion problems through the reduction of water velocities, and the physical protection of the river and stream banks with vegetation. Selection of appropriate planting material can provide for enhancement of aquatic habitat through shading.

Adverse effects include the potential for the deposition of sediment into the watercourse while works are being undertaken. The potential adverse effects can be greatly reduced by following good practice techniques as set out below. The risk of lateral erosion remains until the protective vegetation is well established. The establishment of protective vegetation includes ground surface cover, as well as deeper rooting shrub and tree vegetation.

Guidelines for Good Practice

(a) Always use suitable machinery (such as hydraulic excavator) to minimise the risk of depositing sediment into the watercourse.

(b) Always use an experienced/trained operator on the machine.

(c) Do not carry out excavations or earthworks below the waterline, unless it is necessary to provide for bank stability.

(d) Always pull material away from the watercourse.

(e) Revegetate exposed areas to control surface erosion as soon as practicable following completion of earthworks disturbance.

(f) Fence the exposed area to exclude stock until ground surface is stabilised.

(g) Follow up ground cover planting with shrub and tree vegetation on the stream margins.

Performance Standards

- Excavation shall be undertaken in a manner that minimises the risk of material entering the watercourse.

- All excavation shall be carried out above the water line, unless required for bank stability.

- All exposed areas shall be revegetated as soon as practicable following completion of the work, or at the completion of stages that allow revegetation to be carried out.

- All stock animals shall be excluded from area until vegetation is well established.
- The guidelines for stream bank planting shall be followed when shrub and tree planting is undertaken.

Other Relevant References

Stream bank planting, minor channel widening, minor diversions.

7.2.3 Stream bank Planting

Figure 6 Established buffer zone planting - willows, poplars and native shrubs

Figure 7 Native planting on river margin section

Figure 8 Typical continuous vegetative edge protection

Figure 9 Native stream bank planting

Activity

The planting of specialised vegetation on river and stream banks, including riparian buffer zones. The works are undertaken on a wide range of river and stream systems throughout the Bay of Plenty. The purpose of the plantings is to stabilise the river and stream banks and protect them from lateral erosion problems. The works are undertaken in a manner that will result in a stable regime requiring as little maintenance as possible.

The plantings close to the harsh environment of the river channels and larger streams are normally comprised of specially bred willow species, with other suckering species occasionally used. Outside the willow planting, native pioneer species are planted. Where there is adequate room, production species may be planted outside the native vegetation. The ideal result is a multi-tiered vegetation regime, which has good ground cover as well as shrubs and trees. This regime is also able to help reduce the potential for undesirable weeds to establish.

Planting of the river and stream margins is an activity that is often used as a follow-up practice, after many of the other erosion control or river maintenance operations are completed.

Note: Willows are used immediately adjacent to the channels of rivers and larger streams, because they are able to withstand the harsh environment of the river margins. The willows are specially bred so that they provide a good strong root system, do not spread readily, are not brittle, and are not readily palatable to stock and animal pests. In addition, the ability of the willow to be grown vegetatively (from cut material) means that it provides a potential resource, on site, for future protective works. Willow plantings may not be required on the margins of smaller streams, or larger streams where the gradient is low. In these situations, suitable native shrub species are established.

Resource Management Act 1991

These works are covered under s.9 RMA (use of land), and s.13 RMA (planting in the bed of a river), where planting may be undertaken on dry river bed areas.

Potential Environmental Effects

The effects of not carrying out planting operations means that the river and stream margins will not be protected in a way which helps to ensure long term stability. While the stream margins may revegetate of their own accord, it is not likely to be in the most suitable or environmentally desirable plant material. Without the planting of suitable species, it is possible that the riparian margins will become havens for animal and plant pests.

There are many beneficial soil, water and biodiversity effects associated with the planting of riparian margin areas. Planting gives proactive protection of the river and stream banks from lateral erosion problems. There is an improvement of water quality in the medium to long term through provision of shade, litter, and habitat. Also, during heavy rainfall events, water quality is improved with the filtering of overland flow through the ground vegetation in riparian margins. There is less opportunity for weeds to flourish, if the correct species are established. There is an opportunity to create improved habitat for native terrestrial fauna and flora, as well as wildlife corridors. An increasingly important effect is the ability to enhance the indigenous biodiversity of the stream riparian area.

Adverse effects relate to the requirement for maintenance in the long term to avoid the toppling of trees into the watercourse. While this can be minimised with careful selection of the most suitable plant species, most willow species will require some form of maintenance at least once every 10 years.

Guidelines for Good Practice

(a) Establish plantings (particularly protective ground cover) as soon as practicable following completion of works.

(b) Plant specialised willow and poplar species as edge protection immediately adjacent to the harsh river/high energy environment. (Do not use Crack Willow material for new plantings).

(c) Avoid planting in sites where the plant material may cause a navigation hazard.

(d) Use specially bred willow/poplar material that will not spread by seed, and will not be prone to breakage, if the plant material is available. (See Appendix VII)

(e) Plant pioneer native shrub species (including flax – harakeke) inland from the primary willow plantings, to provide protective vegetation with minimal maintenance requirements.

(f) Always used trained staff for carrying out the planting operations.

(g) Use locally sourced native plant material wherever possible.

(h) Liaise with Department of Conservation to identify suitable native species.

(i) Plant exotic protection/production species further inland from the protection planting, if there is sufficient room.

(j) Avoid introducing exotic species into sites with high ecological values.

(k) Species planted for potential productive purposes should be located so that harvesting operations can be undertaken with minimal environmental effects, including no discharge of sediment or debris into the watercourse.

(l) Fence the protection plantings, and exclude stock.

(m) Control animal and plant pests.

(n) Set planting spaces carefully to achieve a multi-tiered canopy of ground cover/ shrubs/trees in the long term, with reduced opportunity for weeds to flourish.

(o) In wetter areas, plant appropriate species that are adapted to wet conditions (flax, cabbage tree etc).

(p) On smaller streams, avoid the possibility of choking the stream, by planting above the flood level of dominant flow (theoretical channel forming flood).

(q) Avoid use of willows if practicable, in small streams and rivers with low gradients.

Performance Standards

Correct species shall be planted in appropriate locations:

- Specialised willow/poplar species (protection planting)
- Native species (protection and biodiversity planting)
- Wetland species (protection & enhancement planting)

- Production species.
- Plantings are above channel forming flood level.

The planted area shall be fenced and stock shall be excluded.

Animal and plant pests shall be controlled.

Other relevant references

Tree maintenance.

7.2.4 Tree Maintenance

Figure 10 Willow layering - to gain a continuous vegetative edge protection

Figure 11 Five year old willow trees layered

Activity

This activity involves the on-going maintenance of protection plantings on river and stream margins, and includes layering, lopping, trimming and tree removal. Layering is an operation that results in the partial felling of existing willow trees so that the top of the tree is cut to lie on the ground, or against the river bank. However, the stump is not completely severed, and a connection between the stump and the tree remains. Most exotic trees planted for protection purposes will require a degree of maintenance. Some native species may also require maintenance.

This activity will also include the removal of tree material where it is causing problems in river and stream channels. This often occurs after floods, when large trees may have been carried downstream by floodwaters and became lodged in the channel, and cause scouring problems, diverting water etc.

Resource Management Act 1991

These works are covered under s.9 RMA (use of land), and s.13 RMA (planting, removal of vegetation, or disturbance in the bed of a river), where work may be undertaken on river banks or dry river bed areas.

Potential Environmental Effects

Existing willow trees can grow quite large over time. Because of their close proximity to the bank edge, they can become prone to toppling when they grow too large. This weakens the bank and can aggravate lateral erosion. When trees topple they are sometimes carried downstream, where they may then become lodged in places where they may contribute to blockages in flood channels, bridges etc., cause navigation hazards, and contribute to further channel erosion. If the willow trees are not maintained over time, they become a liability in terms of erosion problems.

One of the beneficial effects of maintaining trees, is that the vegetative protection is increased. Shading is provided for the stream environment, as well as shelter for other riparian margin planting. There are a range of other benefits associated with healthy riparian vegetation, including water quality benefits, and provision of terrestrial and aquatic habitat.

Adverse effects of tree layering and maintenance are related to the need to securely anchor the layered willows, to prevent them breaking free and being carried downstream.

Guidelines for Good Practice

(a) Ensure that all operations follow the *Approved Code of Practice for Health and Safety in Tree Work; Part Three; River and Stream Operations,* issued by the Department of Labour.

(b) Ensure that trees are layered where practicable at an age of 8-10 years, or up to 300 mm trunk diameter.

(c) To avoid layered trees being swept away by floods, ensure that a minimum connection of 25% of the tree diameter remains attached to the stump once the tree is felled.

(d) Where less than 25% of the tree diameter is attached, ensure the tree is anchored to the main stump with heavy tie plastic, wire rope or similar effective attachment.

(e) Ensure that trees over 300 mm diameter are layered by utilising a safety device and/or mechanical assistance.

(f) When removing trees from streams/rivers, use the appropriate machinery which ensures that there is minimal damage to the stream and river banks.

(g) When stockpiling of slash and debris, prior to disposal, ensure that it is clear of the flowing waterway, overland flow paths, and planted buffer zones.

Performance Standards

- All practicable measures shall be taken to avoid or minimise the discharge of sediment, vegetative material and other contaminants into water.
- No vegetation, debris, or waste material shall be left in a position where that material could enter water.
- Layered willow trees shall be securely anchored, to avoid being washed downstream in flood water.
- No fuel storage or machine refuelling shall occur where fuel could enter a water body in the event of a spillage.
- All equipment and material shall be left in a safe site above flood level at the end of each working day or when the site is unattended.

Other relevant references

Stream bank planting.

7.3 Hard Engineering Protection Works

Figure 12 Before - note flood damage/severe bank erosion

Figure 13 After - repairs utilising groynes interplanted with willow poles

Figure 14 *Aggradation of silts between training groynes with willow pole plantings and edge protection rock works. This area will become a continuous vegetative edge protection.*

Figure 15 *River training groynes - rail iron and wire rope fences constructed to stop debris and silts*

Figure 16 Rock riprap after a few years vegetation growth

Figure 17 Rock riprap edge protection works

7.3.1 Rock Riprap

Activity

This activity involves the placement of rock directly against river banks to protect the banks from lateral erosion. The use of rock to armour the banks is common on eroding stretches of rivers and larger streams. This method is also commonly used in tidally affected areas where partially saline water precludes vegetative methods of stabilisation.

The purpose of the work is to control lateral erosion of the banks, and rock riprap works extremely well because it provides a flexible form of protection. The rock is able to settle as the channel bed degrades slightly once the bank is protected. The rock protection also provides immediate protection compared to vegetation that takes time to establish.

Resource Management Act 1991

These works are covered under s.13 RMA (disturbance and placement of a structure on the bed of a river), where work is undertaken on river banks or dry river bed areas.

Potential Environmental Effects

Rock riprap protection is used to control active erosion. Therefore the effects of not carrying out the works would be to have the erosion continuing unabated. This would contribute sediment into the stream channel, and aggravate moving bedload problems as well as create further lateral erosion problems downstream. The beneficial effects of using rock riprap are that lateral erosion is controlled and/or prevented.

The adverse effects of using rock riprap are related to short-term disturbance of the river banks while the works are being undertaken. This may also include some battering of banks that may be required to have the rock anchored at the correct batter. Rock needs to be designed and placed properly, with adequate length of protection completed. If insufficient length of bank is protected by rock, it may erode at the end of the rock protection works.

Guidelines for Good Practice

(a) Rock should be placed on a specified design slope.

(b) Rock may require engineering design, including size, grading, shape and quality (soundness, resistance to both abrasion and weathering) specifications. This will ensure that it remains in situ and fulfils its designed function.

(c) Rock should be placed using appropriate machinery unless otherwise specified.

(d) The rock used should be clean quarry spalls ex-face, or other suitable rock material, which is free of soil, mud, clay or other soluble debris.

(e) If concrete is used instead of rock, it should be clean, stable material, not readily broken down, and free of iron, steel, soil, mud, clay, contaminants, or any soluble material.

(f) Well designed and placed rock riprap will settle as the channel stabilises. The rock material may then require maintenance by topping up with further rock, to ensure that it fulfils it's designed purpose. This should only be required once.

Performance Standards

- The rock used shall not react with water in any biological or chemical manner.
- The rock material used shall be free of contaminants.
- The placement of rock shall be carried out in a manner that does not result in any adverse effects on identified fish habitat.
- The placement of the rock shall not result in a navigation hazard.

7.3.2 Gabion Baskets

Activity

This involves the use of wire mesh baskets filled with graded rock to control lateral erosion of river channels. Gabion baskets are not used extensively in the Bay of Plenty, but may be employed on rivers and larger streams. Gabion baskets are used to armour the river banks and are generally non-flexible. Alternatively, gabion baskets can be sized to resemble a mattress - "gabion mattresses" have a degree of flexibility that allows them to settle into scour holes as the channel degrades slightly, following stabilisation of the banks.

Resource Management Act 1991

These works are covered under s.13 RMA (disturbance and placement of a structure on the bed of a river), where work is undertaken on river banks or dry river bed areas.

Potential Environmental Effects

Gabion baskets are only used if the lateral erosion problem is severe and other methods cannot be used. If the lateral erosion was not controlled, it would continue to contribute sediment to the river system. This would, in turn, aggravate moving bedload problems and cause further lateral erosion downstream.

The beneficial effects of using gabion baskets are that lateral erosion is able to be controlled in situations where there is insufficient space to install rock riprap.

The adverse effects of using gabion baskets are that disturbance of the stream bed may be necessary to ensure that the gabion is well founded on an appropriate foundation. This would provide a potential for short term discharge of sediment into the river system. In addition, gabions are prone to corrosion in coastal sites, and to damage where there are high velocities and significant abrasion. Maintenance requirements can be high.

Guidelines for Good Practice

(a) Gabion baskets may require specific design to ensure that the correct size/type of structure and material is used. The mesh should be the most durable material available - currently this is galmac zinc aluminium with PVC coating.

(b) Gabion baskets must always be well founded on a suitable base.

(c) Gabion baskets should be located so that they do not cause a navigation hazard.

(d) During installation, machines should work from the river banks rather instream locations as far as practicable.

Performance Standards

- Gabion baskets shall be well founded.
- Rock used in the Gabion baskets shall be clean material free of soil, mud, clay or other soluble debris.
- Machinery shall avoid working instream as far as practicable.

Figure 18 Beach blading/ripping

7.4 River Channel Maintenance Works

7.4.1 De-armouring (Blading, Ripping, Raking) and Minor Channel Widening/ Diversion

Activity

This activity involves raking and ripping the top layer of gravel (which tends to have an armouring effect) and the loosening or removal of vegetation on dry stream beds, and gravel beaches within a river system, to encourage natural bedload movement during floods. Also included in this activity is the minor channel widening and diversion that is often required in conjunction with erosion protection work. This often involves pulling back beaches that have migrated towards an eroding bank. Excavated material

may be placed against opposite eroding bank. The effect of the minor channel widening/ diversion is that pressure is kept off the eroding bank to allow protection works and vegetation to establish.

The purpose of the river channel maintenance works is to control lateral erosion of the river banks, while at the same time, encourage a degree of natural bedload movement through the river system during flood conditions, with minimal adverse effects. The result that is desired is to have the bedload moving at a natural rate down the river channel, and not aggrading in particular areas and forming beaches which force water flow against adjacent river banks, aggravating erosion problems.

Resource Management Act 1991

These works are covered under s.13 RMA (disturbance of a river bed).

Potential Environmental Effects

If the works are not carried out, there is a potential for beaches to build up and force water onto vulnerable stream and river banks. This can aggravate existing lateral erosion problems, which in turn results in uncontrolled moving bedload problems and lateral erosion of the river banks downstream.

Beneficial effects of the works include the establishment of a more stable bed level, with less risk of river bank erosion. In addition, if carried out in conjunction with erosion control work, there will be less pressure on river bank protection works.

Adverse effects include the potential for elevated levels of suspended sediment, if flooding occurs soon after works are completed. There is also a potential for vegetation debris to enter natural water if not safely disposed of to an off-site location.

Guidelines for Good Practice

(a) Avoid instream works during de-armouring by staying 1 to 5 metres away from flowing water, as appropriate for each site.

(b) Ensure that gravel ripping remains at least 0.3 metres above the water table at the site.

(c) Avoid having machinery entering water unless it is necessary for access to the work site.

(d) When carrying out instream work, use appropriate machinery for the job to carry out work as efficiently as possible, with minimal track movement and/or pushing of material within flowing water.

(e) Avoid operations during bird nesting seasons where habitats have been identified.

(f) Avoid where practicable instream operations during low flow conditions, and during fish spawning/migration periods.

(g) Windrowing of material should be undertaken in a manner that does not prevent access by 4WD vehicles.

(h) Excess vegetation should be disposed off-site where practicable, and not placed where it could readily enter the watercourse.

(i) Existing access tracks to the water edge should be left undisturbed or reinstated when operations are complete.

(j) Ensure that machinery is removed to high ground out of the floodway at the end of each working day, or when site is left unattended.

(k) Ensure that no refuelling operations or storage of fuel occurs where spillage may result in fuel entering natural water.

(l) At the completion of works there should be no depressions that may trap fish during higher flow conditions.

Performance Standards

- Works shall not be undertaken during the nesting season of birds that have identified habitats within or immediately adjacent to the works site.
- Works shall be timed to avoid fish spawning/migration periods (see Appendix VI).
- Instream works shall be avoided by marking boundaries of works site at least 1 metre away from flowing water.
- Machinery shall be kept out of flowing water when ripping operations are being carried out.
- Excess vegetation shall be removed off-site where practicable, and not placed where it could readily enter flowing water.
- No fuel storage or machine refuelling shall occur where fuel could enter a water body in the event of a spillage.
- All machinery and material shall be left in a safe site above flood level at the end of each working day or when the site is unattended.
- Existing vehicle access shall be maintained, or reinstated as soon as possible following completion of operations.

Other relevant references:

Battered banks, stream bank planting.

7.4.2 Weed Control on River Banks, Floodways, and Riparian Buffer Zones Where There is No Discharge of Herbicide to Water

Activity

This activity involves the spot spraying of river banks for weed control, using mainly glyphosate. At times, brushkiller may be used away from the immediate river banks to control specific weeds in the riparian margin area.

The purpose of the works includes the control of excessive weed growth within riparian protection areas, as well as encouraging more desirable species to become established. The removal of unwanted vegetation from the floodway promotes the natural movement of gravel and minimises the uncontrolled build up of sediment. The spread of weed species along these "corridors" requires an ongoing programme of control. This involves a range of methods, including spraying, bio-control, and establishment of more desirable species.

"Total control plant pests" as identified in Environment B·O·P's Regional Plant Pest Management Strategy (RPPMS) will also be targeted in these ways.

Resource Management Act 1991

These works are covered under s.15 RMA (discharge of contaminant onto land where it may enter water).

Potential Environmental Effects

The effects of not undertaking weed control by spraying would be an increase of plant pest species within the riparian protection areas on river and stream margins. Once particular weed species become established, they can be difficult and costly to control effectively, and can spread downstream and on to adjacent land. Plant pests identified under the RPPMS in all situations must be managed in accordance with the requirements of that strategy.

The beneficial effects of carrying out this work are that plant pests are controlled, resulting in more desirable species in riparian protection areas, and a reduction in the proliferation of plant pests. The subsequent long-term benefits are associated with riparian management for a wider range of objectives, rather than just erosion control, flood control, and improved water quality.

Adverse effects include the short-term visual effects of dead weeds, potential fire hazard, potential for damaging non-target species, potential effects on neighbouring properties, and the potential for spray to enter natural water.

Guidelines for Good Practice

(a) All operations should comply with NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).

(b) Avoid spraying onto the surface of water bodies or where herbicide may contaminate water bodies.

(c) Use spot spray techniques, and avoid blanket spraying, as far as practicable.

(d) Ensure correct calibration of spraying equipment.

(e) Use staff that are fully trained in the handling of pesticides, and the use of spray equipment to the standards set out in NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).

(f) Avoid spraying during spawning periods, and minimise spraying during migration periods where a fishery habitat has been identified. Time spray operations for December to mid-February in these areas, as far as practicable.

(g) Use correct chemicals and follow manufacturers instructions.

(h) Dispose of containers or re-use as set out in NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).

(i) Retain a vegetated buffer strip immediately adjacent to the water body wherever practicable.

(j) Always mix sprays well away from watercourse.

(k) Avoid spraying in windy conditions.

(l) Use an adjuvant (such as surfactant, wetter, sticker or filler) to reduce spray drift and enhance effectiveness of herbicide.

(m) Use minimum amount of spray more often rather than concentrated amount less often.

Performance Standards

- Ensure that spraying is only viable option for weed control.
- No mixing of sprays, fuel storage or machine refuelling shall occur where contaminants could enter a water body in the event of a spillage.
- Works shall be undertaken in a manner that avoids the discharge of contaminants into the stream channel as far as practicable, and avoids discharge of contaminants into water during spawning or migration season for identified fisheries habitat.
- All operations carried out shall be in full compliance with the NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).
- Ensure that effects of spraying are avoided for all non-target areas.

Other relevant references:

Stream bank planting, drainage management, weed spraying.

7.5 Management of Drains and Canals

7.5.1 Weed Control by Spraying with Chemical Herbicides Where There is No Discharge of Herbicide to Water

Activity

This activity involves the spot spraying of drain banks for weed control using glyphosate. The operations involve both ground-based operations and the use of a specialised spray boat.

The works are undertaken on the drain banks and berm areas of the Rangitaiki Drainage Area, the Kaituna River Drainage Area, as well as other small drainage schemes. The purpose of the works is to control excessive weed growth on the drain banks and immediate berm areas of the drains so that waterway is maintained, and drain flow is not impeded. There is also an added purpose of eradicating undesirable plant pests.

The only spray used in close proximity to water is glyphosate. Generally, the drainage systems are low quality habitats, and are relatively confined systems.

Environment B·O·P occasionally uses diquat to spray submerged aquatic weed however this activity is controlled by separate resource consents.

Resource Management Act 1991

These works are covered under s.15 RMA (discharge of contaminant onto land where it may enter water).

Potential Environmental Effects

The potential effects of not carrying out the spraying operations would be reduced water flow, higher water table due to poor drainage, and an increase of plant pests within the riparian margin area. There is also a possibility that there would be a reduction in the effectiveness of the flood control schemes that are associated with the drainage schemes.

The beneficial effects include a clear waterway, cleaner water, improved drainage and flood control capability, and a control of the plant pests. In addition, regular weed control often results in an improved aquatic and riparian habitat.

Adverse effects of the works include a short-term visual effect of dead weeds, potential fire hazard, potential for damaging non-target species, potential effects on neighbouring properties, and the potential for spray to enter natural water.

Guidelines for Good Practice

(a) All operations should comply with the NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).

(b) Notify Fish & Game NZ and Department of Conservation as set out in Appendix V.

(c) Consider alternative methods of weed control, and use them where they are likely to be effective, rather than resorting to spraying with chemical herbicide.

(d) Avoid the discharge of herbicide spray onto the water surface of the drains.

(e) Use spot spray techniques, and avoid blanket spraying, as far as practicable.

(f) Ensure correct calibration of spraying equipment.

(g) Use staff that are fully trained in the use of spray equipment and operation of boat.

(h) Use correct chemicals and follow manufacturers instructions.

(i) Use vegetable oil (rape seed) in hydraulic system of the boat.

(j) Dispose of containers or re-use as set out in NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).

(k) Retain a vegetated buffer strip immediately adjacent to the water body wherever practicable.

(l) Always mix sprays well away from watercourse.

(m) Avoid spraying in windy conditions.

(n) Use an adjuvant (such as surfactant, wetter, sticker or filler) to reduce spray drift and enhance effectiveness of herbicide.

(o) Use minimum amount of spray more often rather than concentrated amount less often.

Performance Standards

- Ensure that spraying is only viable option for weed control. (Refer to Appendix V)
- No mixing of sprays, fuel storage or machine refuelling shall occur where contaminants could enter a water body in the event of a spillage.

Figure 19 Weed cutter boat

Figure 20

Typical drain margins following weed cutter boat treatment. Good stable drain margins.

- Works shall be undertaken in a manner that avoids the discharge of contaminants onto the water surface of drains as far as practicable.
- All operations shall be carried out in full compliance with the NZS 8409:1999 Code of Practice for the Management of Agrichemicals (GROWSAFE®).
- Ensure that effects of spraying are avoided for all non-target areas.

7.5.2 Weed Control by Cutting Weeds Using Weed Cutter Boat

Activity

This activity involves the trimming of aquatic weeds using a purpose-built weed cutter boat. The weeds are trimmed just above bed level and are removed from the channel where possible. Alternatively, the weeds are left to flush down the drains and disperse over time.

The purpose of the works is to control excessive growth of aquatic weeds, so that the waterway is maintained, and water flow is not impeded.

Providing the weed cutting is undertaken on a regular schedule, discharge of cut weed into the channel can be reduced to such an extent that the effects are minimal. This is particularly apparent when compared to alternative methods of aquatic weed control. Cut weed material is to be disposed of to land whenever practicable.

Resource Management Act 1991

These works are covered under s.15 RMA (discharge of potential contaminant into water).

Potential Environmental Effects

The effects of not undertaking weed control using the weed cutter boat would be reduced water flow, higher water table due to poor drainage, and an increase of plant pests within the riparian margin area. There is also a possibility that there would be a reduction in the effectiveness of the flood control schemes that are associated with the drainage schemes. Excessive weed growth produces wide fluctuations in pH and oxygen to the extent that aquatic life is affected. Permitting some degree of weed growth increases habitat complexity for fish and invertebrates.

Using the weed cutter boat is preferable to other methods of weed control, as there is no disturbance of the drain beds or banks, and no use of sprays. The activity is quick and effective, with less disruption to habitat. The riparian vegetation on the drain margins is left undisturbed, and wild life, (such as ducks) remain in the immediate vicinity while the operations are being carried out.

Adverse effects from the operation are as a result of any dead vegetation left in the water. This may result in a very short-term degradation in water quality, particularly a drop in oxygen levels. Given the high organic load on these waterways, and slow flow, this has the potential to kill aquatic life. The likelihood of this happening can be reduced by cutting more regularly. Where there is little flow, the dead weed is flushed out more slowly. In these habitats especially, the chances of deoxygenation are lower using the weed cutter boat compared to herbicides, as the weed is cut live and has some chance of being flushed through the system. The chance of spreading noxious weeds is increased compared with spraying. Where the flows are greater, the dead weed is generally flushed out in 24-48 hours, and any adverse effects are largely confined to short-term nuisance effects on downstream recreational users. More regular cutting results in fewer weeds being flushed through the system, and less potential for adverse environmental effects.

Guidelines for Good Practice

(a) Use the weed cutter boat often to reduce the amount of weed cut in any particular operations.

(b) Use vegetable oil (rape seed) in the hydraulics of the boat.

(c) Use only fully trained staff in charge of the weed cutter boat operations.

(d) Wherever practicable, remove cut weeds from the waterway and dispose of the material on dry land.

(e) Remove all material when a channel blockage occurs.

(f) Ensure that no refuelling operations or storage of fuel is carried out where spillage may result in fuel entering natural water.

Performance Standards

- Only trained staff shall operate the weed cutter boat.
- The weed cutter boat shall be well maintained so that the likelihood of fuel leakage is minimised as far as practicable.
- Cut material shall be removed from the waterway and safely disposed of, on dry land as far as practicable.
- Any cut weed that is causing a channel blockage, or significantly obstructing the free flow of water, shall be removed from the waterway as quickly as possible.
- No refuelling operations or storage of fuel shall be carried out where spillage may result in fuel entering natural water.

7.5.3 Desilting of Drains Using Ground Based Machinery

Activity

This activity involves the excavation of material from the bed of a drain using a hydraulic excavator. The purpose of the work is to remove excess sediment deposited on the channel bed, and also to remove weeds from the channel. This ensures that the channel capacity is maintained.

The desilting operations are commonly known as “drain cleaning” and are undertaken within the Rangitaiki and Kaituna Drainage Areas, as well as other minor drainage areas.

Resource Management Act 1991

There is a potential for these works to be subject to s.15 RMA (discharge of potential contaminant into water). The works are carried out under the Land Drainage Act 1908, and the drains are not defined as rivers under the Resource Management Act 1991. However, there may be some situations where drain cleaning may require a resource consent pursuant to s.15 discharge of contaminant (sediment) to water, in respect of the discharge at the outlet of the drainage system into a stream or modified watercourse. However, generally, the drainage areas where mechanical desilting is undertaken, are relatively closed systems, with little apparent discharge of contaminants into specific water bodies.

Potential Environmental Effects

The effects of not carrying out desilting of drains are far reaching. The drainage of the Rangitaiki and Kaituna Drainage Areas, as well as other small drainage schemes, provides for farmland to carry on as productive enterprises. In addition, many of the drainage schemes are integrated with flood protection schemes, and the maintenance of both drainage and flood control, is essential to ensure that both continue to fulfil their respective functions. If desilting of drains were to lapse, there would be excessive sediment build-up, as the drains have a low gradient. This would, in turn, result in blocked waterways, poor drainage, possible slumping of stream banks, and corresponding flooding problems. There could also be a drop in water quality due to slow water flow.

The beneficial effects of cleaning out drains include having clean drains and water in the medium term, as well as improved drainage (due to lowered water tables) and flood control (with provision for ponding within drainage canals).

Desilting operations result in a uniform environment that limits habitat quality for stream life. The adverse effects of drain cleaning operations include the short-term suspended sediment load and the potential for stream bank erosion if the operations are not carried out correctly. In addition, there can be adverse effects on any fisheries habitat, through the removal of benthic material and fish life, and smothering of the bed with sediment from the operations. The deposition of unconsolidated bed material on the drain bank can have adverse effects if not managed with care.

Guidelines for Good Practice

(a) Always consider other alternatives prior to carrying out desilting operations.

(b) Works should be designed, supervised and implemented to carry out the minimum amount of excavation necessary.

(c) Machinery used to do the work should be suitable for completing the work quickly and with minimal impact.

(d) An experienced operator should always be used.

(e) Excavate stream bed only, avoiding progressive deepening of the drain, and disturbance to banks, as far as practicable.

(f) Excavate a sediment settling area (slightly deeper) at the downstream end of the work where practicable.

(g) Time the operations to avoid fish spawning as far as practicable, and to minimise impact on migration, when working in or upstream of identified native fishery habitats.

(h) Deposit the spoil well away from the edge of the channel. Stockpile or spread in consultation with the landowner. Spread out to maintain a gradient towards the channel at a later time.

(i) Monitor for post-excavation problems (stream bank/slump erosion).

(j) Work from upstream heading downstream, so that disturbed vegetation can be continually removed.

(k) Sow grass (annual species) on exposed ground following completion of operations.

Performance Standards

- Ensure that no refuelling operations or storage of fuel are carried out where spillage may result in fuel entering natural water.

- Operations shall be to avoid fish spawning, and to minimise impact on migration, when working in or upstream of identified native fishery habitats

- Excavation operations shall be from the stream bed only (without over deepening), avoiding disturbance to banks, as far as practicable.
- Spoil shall be deposited well away from the edge of the drain and not left in a position where it may enter or fall into the water body.
- Spoil material shall be graded back towards the drain after the material is suitably dry.
- All exposed areas of ground shall be regrassed or effectively stabilised as soon as practicable following completion of the operations.
- Operations shall be monitored for erosion problems up to 2 months after completion.

7.5.4 Salt Water Flushing

Activity

This activity involves the flushing of salt water into drains and canals, by allowing the incoming tide to discharge back into the drains, through securing the floodgates open.

The purpose of this operation is to encourage the tidal flushing of drainage systems, so that the salinity of the seawater is used to control excessive weed growth. It is practised in the lower tidal areas of the river and drainage schemes.

Resource Management Act 1991

As these drainage networks are normally part of a natural drainage system, the activity is not specifically controlled under RMA.

Potential Environmental Effects

If salt water flushing was not carried out, there would be reduced water flow and poor drainage due to weed growth during winter, and a very low surrounding water table and stagnation of channels during dry/low flow conditions over summer.

Experience has shown that there are several beneficial effects of this practice during summer. These include raising the surrounding water table levels, reducing peat shrinkage, improved eel habitat, recreational opportunities for bathing, and maintenance of a clear waterway with improved drainage and flood control. With the regular flushing of new saline water, there is an improvement in water quality, and improved fish access.

Adverse effects include the potential for beneficial stream bank vegetation to be destroyed if it is not saline tolerant, and saline intrusion into groundwater.

Guidelines for Good Practice

(a) Avoid salt water flushing operations during winter period and flood conditions.

(b) Carry out necessary floodgate maintenance in conjunction with salt water flushing.

Performance Standards

- Operations shall not be carried out during winter and/or flood conditions.
- Stream bank vegetation shall be monitored to ensure it is not adversely affected following salt water flushing operations.

Chapter 8: Conclusion

The Operational Services Group of Environment B·O·P has a responsibility for management of specific drains and rivers within the Bay of Plenty.

The responsibilities cover flood control, water level control, erosion control, river management and drainage management. At the same time as reducing flooding and erosion problems, there is a need to achieve a healthy river system that can sustain aquatic life.

River and drainage activities attempt to control the tendency of watercourses to meander in a flood. To some extent this tendency is natural, but has been exacerbated by changes in runoff patterns as a result of changes in catchment land use, as well as removal of riparian vegetation that stabilises river and stream banks.

This Code of Practice covers the maintenance of existing river and drainage scheme works. The schemes are part of the existing physical environment, and require on-going management if they are to continue to function successfully. If they are not maintained, there is a potential threat to the safety and well being of communities, as well as to the productivity of rural and urban areas. Experience has shown that unmanaged river systems tend to take a longer time to revegetate and recover following floods, than a well managed river system. Therefore, some degree of active maintenance is essential to ensure the schemes works are managed sustainably for the long term benefit of the community.

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Glossary

Adjuvant Any substance other than water that is designed to enhance the effectiveness of a chemical herbicide. Often works by reducing drift or giving better surface coverage, or allowing the herbicide to stick to the target plant for a longer period.

Aggradation The build up of bed level in a river as material is deposited over time.

Alluvial Flood Plains Flood plains made up of sediment carried by rivers and deposited as the river meanders across the landscape.

Biodiversity The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Benthic Dwelling or found on the bed of a stream or river.

Berm Flood plain of a stream or river.

Caldera A large basin shaped volcanic depression, typically originating through volcanic explosion and/or collapse.

Fan deposit Material deposited as a fan at the mouth of a valley, gully or gorge.

Fluvial The action of running water as overland stormwater flow, in rivers or streams.

Greywacke Rock formed from sand sediment deposited on an ancient sea bed.

Lapilli Very loose to compact pumice material, commonly non-cohesive, with a grain size of coarse sand to medium gravel.

Mitigation Reduction in severity.

Quarry Spalls Rock material taken directly from the quarry face without crushing. Often hand picked to meet minimum/maximum size range.

Remedy Put right or make good.

Reno Mattress Erosion control structure made up of rock material within a wire mesh flat basket likened to a "mattress". Often used as an energy dissipater.

Riffles River flow conditions where shallow water runs over gravel. Often found on straight channel sections before deeper pools that may occur on bends.

Riparian Buffer Zone A strip of land adjacent to a stream or river that is vegetated to control stream bank erosion, and to act as a filter to reduce contaminants from the land entering the stream.

Rock Riprap Angular rock placed on-site as an erosion control measure. Commonly used to control bank erosion on rivers.

Surfactant Any chemical that increases the wetting, spreading or penetration properties of a herbicide.

Tectonic Applying to the movements of the earth's crust, including earthquakes.

Tephra Deposits The layers of volcanic ash and lapilli resulting from a volcanic eruption.

Terrestrial Dwelling or found on the land.

Windrowing Placement of vegetation and debris material in rows generally by using earthmoving machinery.

Appendices

Appendix I - Legislation Relating to Rivers and Drainage Activities

Appendix II - Example of E-mail Notification Form Used by Rivers and Drainage Section

Appendix III - Works Completion Form, River & Stream Works

Appendix IV - Consultation and Notification Process

Appendix V - Selection Method for Drain Maintenance

Appendix VI - Native Fish Spawning and Migration in Drainage Areas

Appendix VII - Uses and Management of Willow Species: Sustainable Options SC 21/98

Appendix VIII - Providing for Protection of Archaeological Sites in Rivers and Drainage Activities: Procedure.

Appendix IX - River and Drainage Scheme Locality Maps

Appendix I - Legislation Relating to Rivers and Drainage Activities

The Bay of Plenty Regional Council (Environment B·O·P) has functions, duties and powers relating to rivers and drainage activities, under the following legislation:

1 Soil Conservation and Rivers Control Act 1941: To conserve soil resources, control erosion and provide for flood protection.

2 Land Drainage Act 1908, Rangitaiki Land Drainage Act 1956: To manage drainage works and pumped drainage schemes.

3 Local Government Act 1974, Rating Powers Act 1988: To administer soil conservation, river and drainage schemes as a territorial authority.

4 Resource Management Act 1991(RMA): Section 30 sets out the functions of regional councils. This includes the following clauses from Section 30 RMA:

Section 30 - The control of the use of land for the purpose of -

(c) (i) Soil conservation:

(ii) The maintenance and enhancement of the quality of water in water bodies and coastal water:

(iii) The maintenance of the quantity of water in water bodies and coastal water

(f) The control of discharges of contaminants into or onto land, air, or water and discharges of water into water:

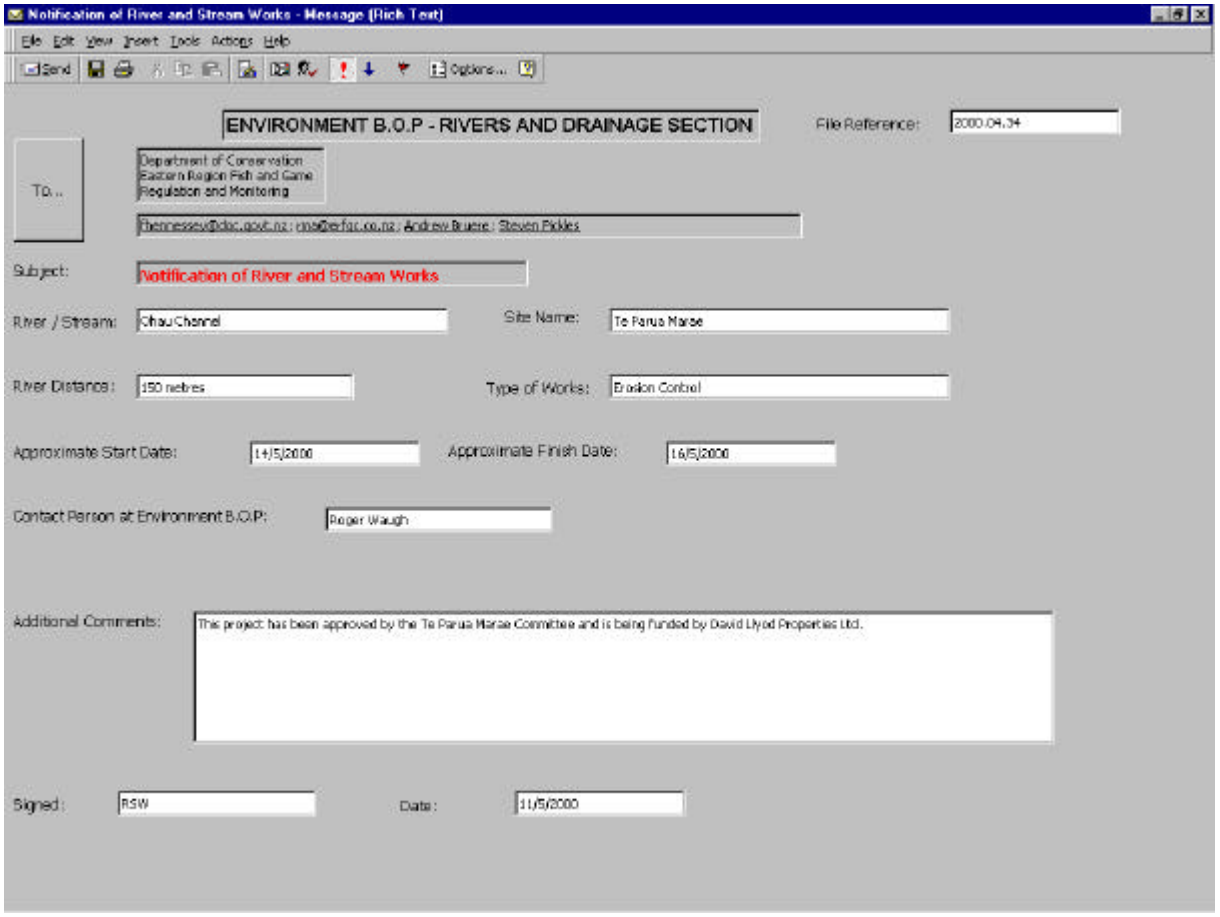
(g) In relation to any bed of a water body, the control of the introduction or planting of any plant in, on, or under that land, for the purpose of-

(i) Soil conservation:

(ii) The maintenance and enhancement of the quality of water in that water body:

(iii) The maintenance of the quantity of water in that water body:

Appendix II - Example of E-mail Notification Form Used by Rivers and Drainage Section


Notification of River and Stream Works - Message (Rich Text)

File Edit View Insert Tools Actions Help

Send Options...

ENVIRONMENT B.O.P - RIVERS AND DRAINAGE SECTION

File Reference: 2000.04.34

To...

Department of Conservation
Eastern Region Fish and Game
Regulation and Monitoring

thennessey@doc.govt.nz; rms@refgc.co.nz; Andrew Bruere; Steven Pickles

Subject: Notification of River and Stream Works

River / Stream: Ohau Channel

Site Name: Te Parua Marae

River Distance: 150 metres

Type of Works: Erosion Control

Approximate Start Date: 14/5/2000

Approximate Finish Date: 16/5/2000

Contact Person at Environment B.O.P: Roger Waugh

Additional Comments: This project has been approved by the Te Parua Marae Committee and is being funded by David Lloyd Properties Ltd.

Signed: RSW

Date: 11/5/2000

Appendix III - Works Completion Form
River & Stream Works

Environment B·O·P– Rivers and Drainage Section **File Reference:**

Works Completion Form - River & Stream Works

River/Stream:_____ **Site:** _____

Type of Works:_____ **Date:**_____

Checklist to ensure compliance with performance standards.
(Tick box if performance measure has been satisfied. If performance standard has not been met, an explanation should be provided in the comments section.)

No discharge of sediment or debris into stream or river. ☐

Structures, trenched and layered willows securely anchored. ☐

No adverse effects on fisheries habitat or birdlife habitat. ☐

Works do not pose a hazard to navigation. ☐

No fuel spillage, fuel or oil leaks. No discharge of contaminants, sprays etc. ☐

No disturbance of archaeological/historic or cultural sites. ☐

No slash or debris left in floodway. All rubbish cleaned up. Site left tidy. ☐

Retirement fencing constructed ☐

Revegetation on completion of works: Grass sown (Surface cover) ☐
Planting completed (Trees/shrubs) ☐

Rock rip-rap: Material meets specifications and free of any debris ☐

Comments: (Add further comments overleaf if necessary)

_____

_____

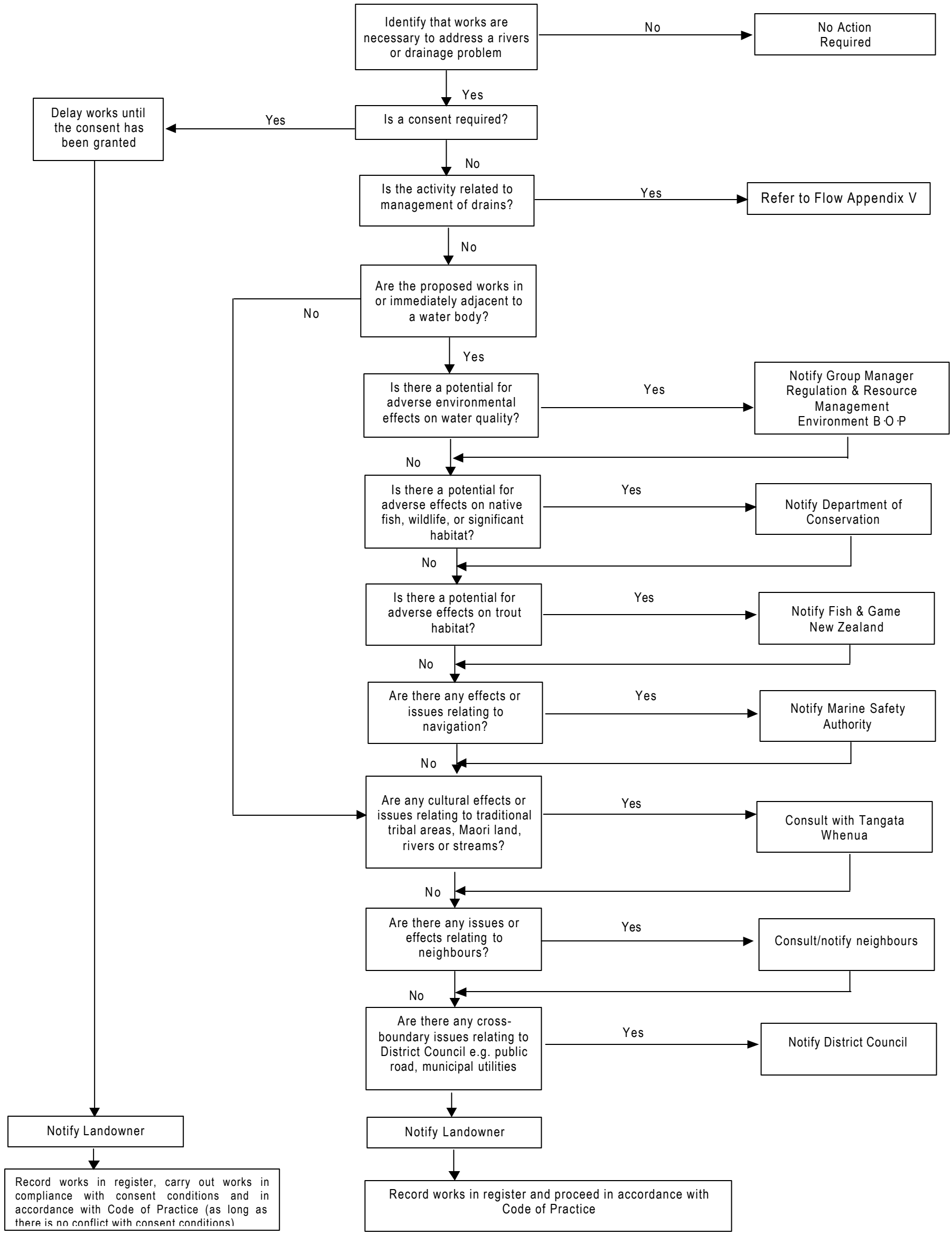
_____

_____

Signed: _____ **Position:** _____

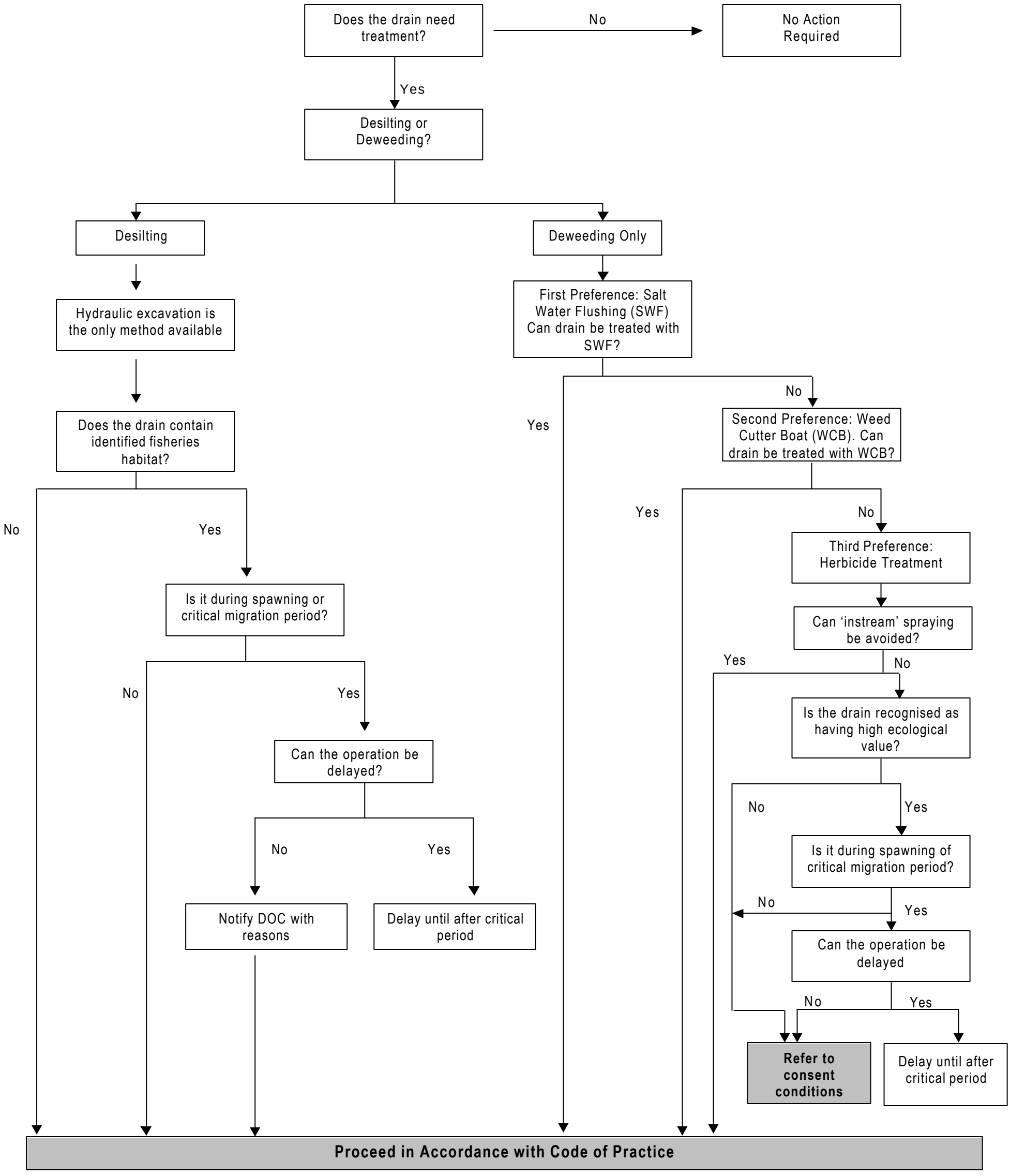
Appendix IV - Consultation and Notification Process

Consultation and Notification Process Prior to Carrying Out Rivers and Drainage Activities



Appendix V - Selection Method for Drain Maintenance

Selection Method for Drain Maintenance



Appendix VI - Native Fish Spawning and Migration in Drainage Areas

Canal	Native Fish Spawning and Migration in Drainage Areas																							
	Tidal Reaches Only												All Reaches of the Canal											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rangitaiki Plains																								
Awaiti Canal																		■	■	■	■	■	■	■
Omeheu Canal														■	■	■	■							
Awakaponga Canal and Stream																					■	■	■	■
Waikamihi Stream																				■	■	■	■	■
Mangaone Stream														■	■	■	■	■			■	■	■	■
Western Drain																					■	■	■	■
Ngakauroa Drain/Stream																■	■	■			■	■	■	■
Te Rahu Canal																					■	■	■	■
Otarere Stream/Drain																					■	■	■	■
Reids Central Canal																				■	■	■	■	■
Te Puke Kaituna																								
Kopuroa/Kopuaroa Canal																					■	■	■	■
Ohineangaanga Canal																				■	■	■	■	■
Raparahoe Canal																					■	■	■	
Waiari Stream																					■	■	■	■
Little Waihi Estuary																								
Kaikokopu Canal			■	■	■																■	■	■	
Pongakawa Canal			■	■	■												■	■	■	■	■	■	■	■
Pukehina Canal			■	■	■																			

Canal	Native Fish Spawning and Migration in Drainage Areas																							
	Tidal Reaches Only												All Reaches of the Canal											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Waioeka/Otara																								
Kukomoa Creek																								
Papamoa																								
Papamoa Drain																								

Appendix VII - Uses and Management of Willow Species: Sustainable Options SC21/98

ENVIRONMENT B·O·P

Bay of Plenty Regional Council

Soil Conservation Practice

USES AND MANAGEMENT OF WILLOW SPECIES

Fact Sheet SC21/98

Sustainable Options

Introduction

High root mass, fast growth rate and good tolerance of wet soils mean willow species are ideal for controlling erosion on river and stream banks. Willows are also a multipurpose group of species, with traditional uses ranging from fencing and basket work to charcoal manufacture. Internationally, willow wood is currently used for boxing, pulp and fibre board production, and items such as cricket bats. In New Zealand willows are used for erosion control, shelterbelts and sometimes as a fodder source for bees or livestock.

The willow family (*Salix* species) is group of a highly evolved, deciduous, riparian species which compete vigorously with most indigenous plants. In New Zealand erosion control cultivars, as opposed to naturalised species, have been carefully selected with minimal capacity for invasive spread. End users should be aware of this and select the correct clonal material when planting around wetlands or waterways. **Use only named, male cultivars in these situations.**

Selecting Willow Cultivars

Within the willow family there are two sub–genera, commonly known as tree willows and the shrub willows. Tree willows grow up to 20m high and have single trunks (sometimes as short as 2m) between 60cm and 90cm in diameter. Leaves are lance shaped with long tapered tips and catkins (flowers) appear at the same time as new leaves in spring.

The spreading form of crack willow (S. fragilis), a naturalised tree willow species

A S.matsudana x alba tree willow clone bred for soil conservation

Note improved form compared with naturalised species.

Shrub willows comprise two sub groups; the osiers and the sallows. Osier willows form medium size shrubs up to 8m high with multiple stems arising from the base of the plant. Stem diameters can vary from 12–15mm up to 20cm depending on species and age of plants. Leaves are 5–10 times longer than they are wide and catkins appear 2–3 weeks before leaves.

Sallows are also multiple stemmed and carry stout branches. Form varies from low shrubs to small trees depending on the particular species. Leaf length is 2–3 times that of leaf width, and leaves are oval to round in shape. Catkins appear several weeks before leaves.

For soil conservation purposes tree willows are used where a deep, extensive root mass is required for soil stabilisation. Shrub willows are used to control erosion by running water because their dense root mats resist scouring. Shrub willows also have a smaller aerial mass (compared with tree willows) which is a management advantage in some situations. Although the root mass of shrub willows is dense it is limited in extent. Under conditions of high stream bank erosion pressure, these limited root systems can be under cut, and mixed tree/shrub willow plantings are recommended where this risk is present.

Establishment and Management

All willow material will strike readily from woody cuttings and no specialised propagation techniques

Caring for the Bay of Plenty

Table 1 — Tree Willow Cultivars

Species	Cultivar (Clone No)	Characteristics	Uses
Salix matsudana	PN 227	Tolerates drier soils than most other willows; develops early rough bark. Large spreading tree becoming prone to wind damage with age. Moderate susceptibility to leaf rust. **Female**	Soil conservation, shelterbelts (requires side trimming)
S.matsudana	Shanghai (PN 695)	Faster growing than PN 227 but similar drought tolerance and early rough bark formation. Broad crown, best planted in gullies and form pruned to reduce wind breakage. Moderate susceptibility to leaf rust. **Female.**	Soil conservation.
S.matsudana	Tsinan (PN 694)	Similar to PN 695 but faster growing and more susceptible to wind damage. Has less palatability to possums in the second year after planting. Moderate susceptibility to leaf rust. **Female.**	Soil conservation.
S.matsudana x alba	Adair (NZ 1143)	Reasonably narrow crown; leafs out early in August. **Male.**	Soil conservation, shelterbelts, river control.
S.matsudana x alba	Aokautere (NZ1002)	Susceptible to Marsonnina leaf spot disease and not recommended for humid areas. Fairly narrow crown, less susceptible to wind damage than PN 227 parent. **Male.**	Soil conservation.
S.matsudana x alba	Hathaway (NZ 1317)	Growth rate and form intermediate between NZ 1130 and NZ 1149. Has a degree of possum resistance. **Male.**	Soil conservation, river control, amenity.
S.matsudana x alba	Hiwinui (NZ 1130)	Rather spreading crown and pendulous lower branches. **Male.**	Soil conservation, river control, bee forage, amenity.
S.matsudana x alba	Moutere (NZ 1184)	Fast growing, reasonably narrow crown. Good for erosion control on streambanks, in gullies and on foot slopes. **Male.**	Soil conservation, shelterbelts, river control.
S.matsudana x alba	Tangoio (NZ 1040)	Better form for shelter and not as vigorous as other hybrids. More drought tolerant than Moutere and more suitable for planting on hillsides. **Female**	Soil conservation, shelterbelts.
S.matsudana x alba	Wairakei (NZ 1149)	Fast growing, moderately spreading crown. **Male.**	Soil conservation.

are required. Willows can be planted out directly as 20cm cuttings, 60– 100cm stakes or as 2.5m–3.0m long poles.

For establishment of cuttings and stakes, exclude livestock from plantings and control weeds or moisture competition will cause heavy losses in the first season. The preferred material for establishing tree willows in shelterbelts is one year old sapling material (2.5 – 3 m high) commonly called "rooted cuttings". All willow planting, of rooted or unrooted material, should be done during dormancy i.e. June to August.

To establish tree willows in the presence of livestock, plant 3m poles to a depth of at least 80cm using a pole driver. (see adjacent photo). If cattle are present, such material should have a butt (large end) diameter of at least 80mm, and the pole should be straight. A pole protector is also required.

Using the 'Y Bar' pole planter. Spiked end forms 60cm deep guide hole and pole is driven at least 20cm lower than depth of guide hole.

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Table 2 — Shrub Willow Cultivars

Species	Cultivar (Clone No.)	Characteristics	Uses
Salix purpurea	Booth (PN 249)	Shrub or small tree (7-8m), flexible branches resistant to breakage. Best in gullies or along stream banks, can be used as an initial stabiliser on sites being revegetated with native plants. Triploid female, **Sterile**.	Soil conservation, revegetation, river control.
S.purpurea	Holland (PN 605)	Shrub (to 7m) with spreading habit and flexible branches, similar to Booth. Best in gullies and along stream banks. **Male.**	Soil conservation, river control.
S.purpurea	Iette (PN 606)	Shrub to small tree (7-8m), upright habit. Performs well at higher altitudes but not drought tolerant. Good dense root system for stream bank stabilisation. **Male**	Soil conservation, river control, lower stratum in windbreaks.
S.purpurea	Pohangina (NZ1087)	Shrub (7-8m) moderately spreading. Vigorous, slender, flexible stems. **Male.**	Soil conservation, river control.
S.alaagnos x daphnoides	Tiritea (NZ 1012)	Shrub (to 8m), very vigorous. Multi-stemmed with an open upright habit and flexible branches, slightly susceptible to leaf rust, not tolerant of dry conditions. . **Male**	Soil conservation, river control.
S.glaucophylloides	Glenmark (CM4)	Clonal mix shrub (6-8m), multi-stemmed and spreading. Vigorous on most sites and grows well on high country sites. Tolerates acid soils. Foliage moderately palatable to possums. **Male.**	Soil conservation, river control
S.repens x purpurea	Kumeti (NZ1057)	Semi prostate shrub (2-3m) with many almost horizontal branches. Medium growth rate, suitable for low ground cover. **Male.**	Soil conservation, river control.
S. x reichardtii (= S."discolor")	PN 215	Shrubby tree (to 10m), erect, multi-stemmed habit. Tolerates drier conditions than most willows, moderately tolerant of salt winds and tolerates acid soils. Slightly susceptible to leaf rust. **Male.**	Soil conservation, windbreaks
S. viminalis	Kinuyanagi (PN 386)	Large shrub to small spreading tree (8 x 6 m) very vigorous on moist fertile sites once established. Leaves are silvery underneath. Performs well as a coppice fuel wood and forage species. High tannin levels in foliage reduce palatability to livestock after mid summer. **Male.**	Forage, fuel wood, amenity.

If the planting is not going to be exposed to cattle for the first two seasons, a Treegard® (plastic netting) sleeve is suitable. This requires fixing in place with a small (15mm) staple top and bottom, and will eventually breakdown at around 6 or 7 years after planting when the tree has developed robust bark and a diameter of 20cm or more.

If the planting is going to be exposed to cattle at the outset, the use of Dynex® (smooth plastic) sleeves is recommended. This sleeve discourages stock rubbing but poles may be broken if less than the minimum recommended butt diameter. Dynex® sleeves are designed to split off trees as they outgrow the sleeve. When this happens, bark under the sleeve is tender and has a limited period of susceptibility to stock damage. When trees show the first signs of outgrowing Dynex® sleeves, remove the sleeves and exclude stock from the planting for at least three weeks to allow bark to harden. This operation is best performed in late summer/early autumn.

Pole plantings benefit from pruning, to maintain good form and reduce pasture shading. Two years after planting, most of the growth on the top of the pole can be removed to leave a single strong leader. Subsequent pruning can be applied at two-yearly intervals to remove forking and to maintain a single leader. Once stem diameter has attained at least 12cm, side lift pruning will reduce pasture shading and provide some forage. Willow leaves and soft stems have a digestibility of up to 80% and are readily eaten by livestock. Some species have high tanin levels which can benefit stock health. All pruning operations are best carried out in early autumn.

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Cattle browsing one year old coppice growth in a fodder block of 'Kinuyanagi' willow.

Pest and Diseases

Certain willows suffer a degree of susceptibility to leaf spot and rust diseases (see Table 1 and 2). Under highly humid seasonal conditions these may lead to partial defoliation in mid to late summer. This reduces the vigour of the host plant but rarely results in plant death. Willows are also susceptible to the systemic fungus known as silver leaf (*Chondrostereum purpurea*) which enters plants through pruning wounds and is most commonly found in pole nurseries. A spray containing 3% solutions of the fungicides Captan and Euparen® is used on freshly cut stumps to protect against this disease. Field pruning under dry conditions (in autumn) generally avoids infection.

Two types of sawfly attack willows in New Zealand. One, *Pontania proxima*, typically forms reddish galls on the foliage of certain tree willows in mid summer, but has a limited effect in tree health/vigour. The other, *Nematus oligospilus*, eats foliage and where rapid expansions of this insect population occur in mid summer, significant (but temporary) defoliation of established trees can result. Naturalised species such as the crack willow and the Golden Willow are severely affected. This insect is a relatively recent introduction and information is still being gathered about its behaviour in New Zealand. Laboratory tests indicate that most tree willows are generally palatable to this insect, while shrub willows exhibit varying degrees of resistance.

Most tree willows, especially the *S.matsudana* x *alba* hybrids, are also susceptible to possum attack. The "Hathaway" cultivar has some resistence but will be attacked where possum numbers are high. Dynex® sleeves offer some protection against possums, otherwise protectors can be made from sections of aluminium printing plate folded into tube shapes and stapled onto poles. Alternatively, consult an Environment B·O·P Animal Pest Officer about suitable methods for possum control.

Willow pole one year after planting protected by Treegard® sleeve and aluminium possum protector

For further information contact a local Environment B·O·P soil conservator on freephone 0800 ENVBOP (368 267)

Environment B·O·P offices located at:

6 Rata Street	**Mt Maunganui**
1125 Arawa Street	**Rotorua**
5 Quay Street	**Whakatane**
25 Church Street	**Opotiki**

Email: info@envbop.govt.nz

Further Reading

Plant Materials Handbook for Soil Conservation, Vol. I & II CWS van Kraayenoord and R L Hathaway (eds.) Soil and Water Misc. Publication No. 93 & 94. NWASCO, Wellington (1986)

Introduced Forest Trees in New Zealand, No. 15 The Willows CWS van Kraayenoord, B. Slui and F B Knowles. FRI Bulletin No. 124 Forest Research Institute (1995)

Sustainable Options SC16/98 Farm Shelterbelts Environment B·O·P (1998)

This fact sheet was prepared by Colin Stace

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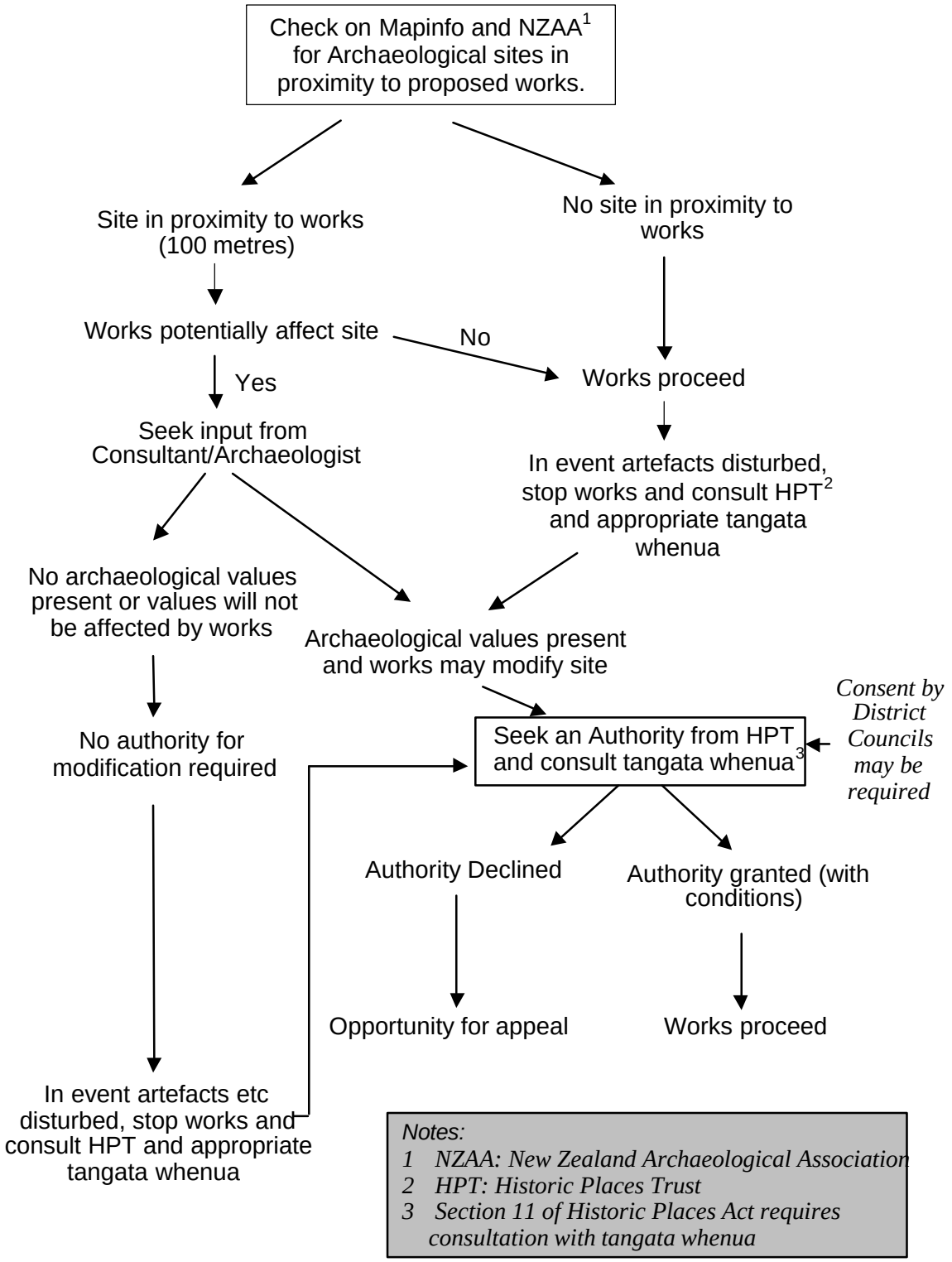
Caring for the Bay of Plenty

Appendix VIII - Providing for Protection of Archaeological Sites in Rivers and Drainage Actities: Procedure



Appendix IX - River & Drainage Scheme Locality Maps

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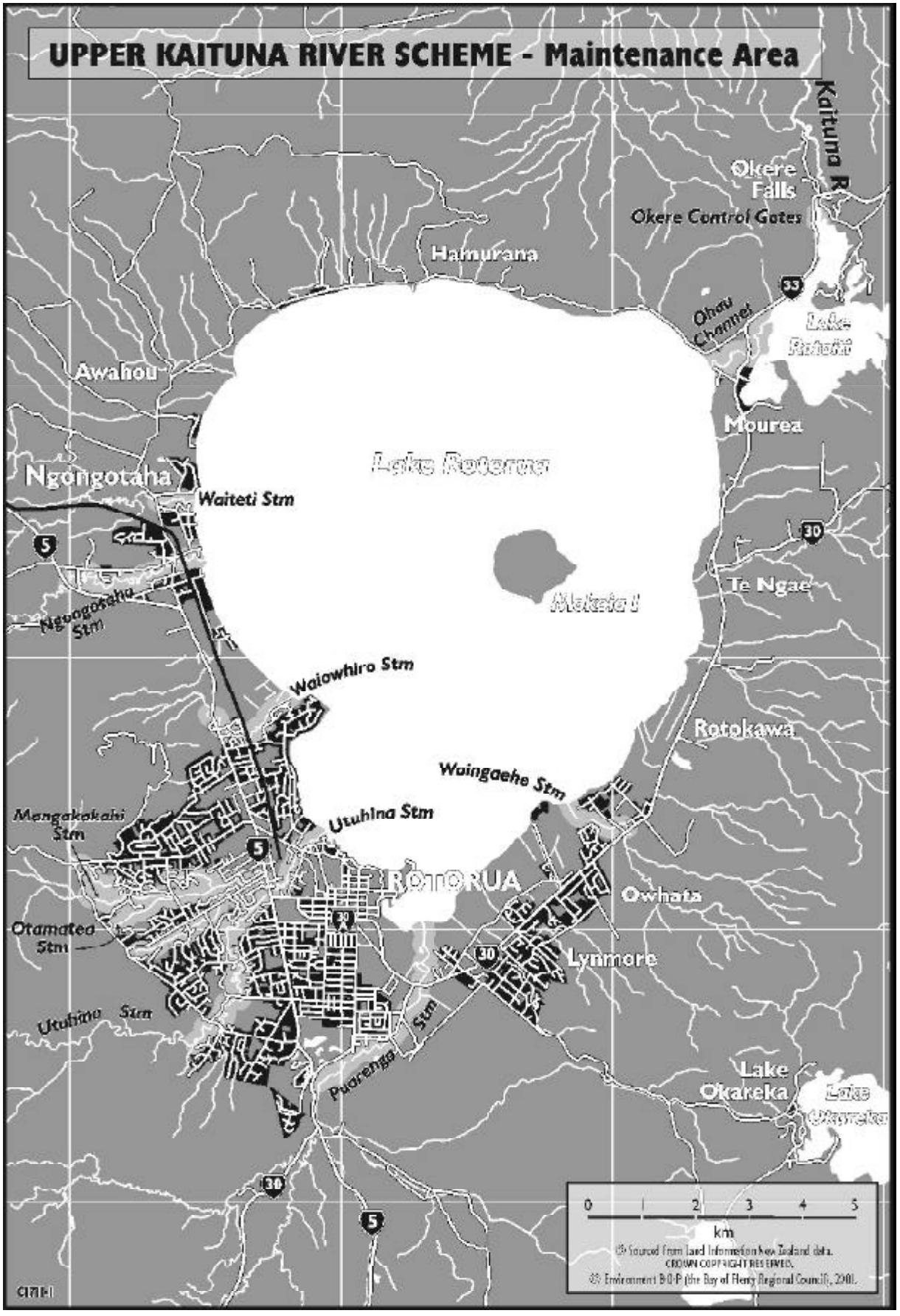

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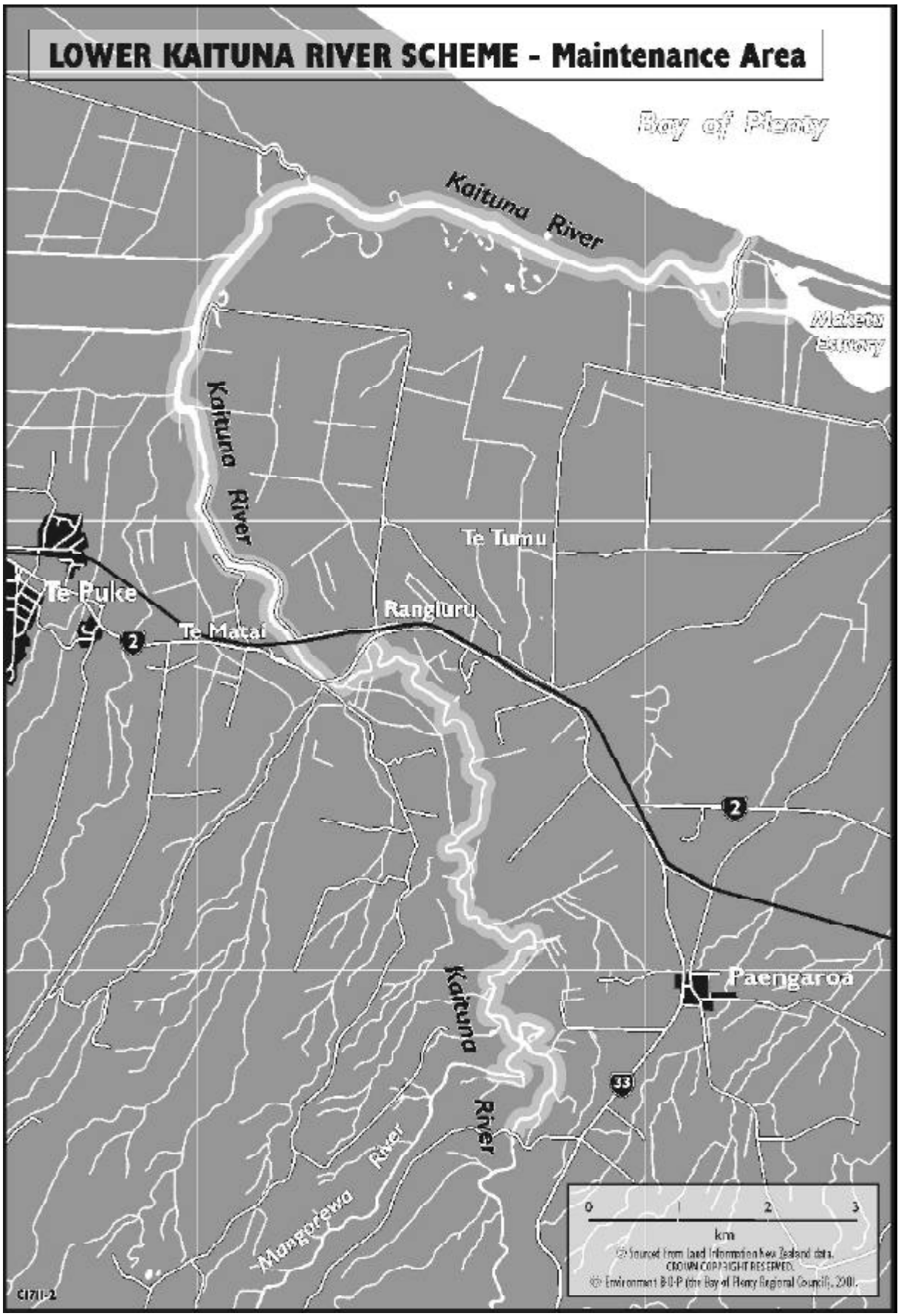

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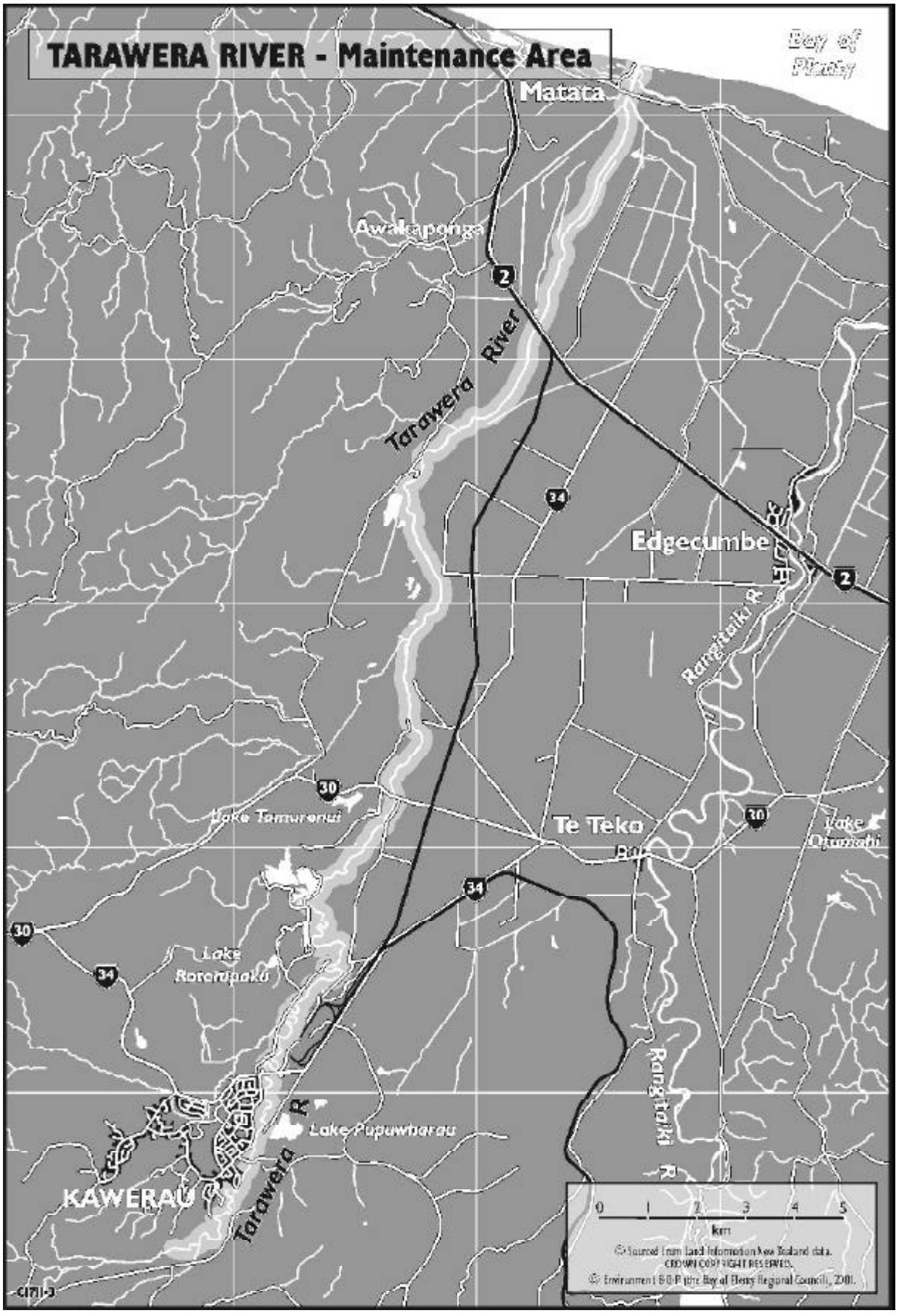

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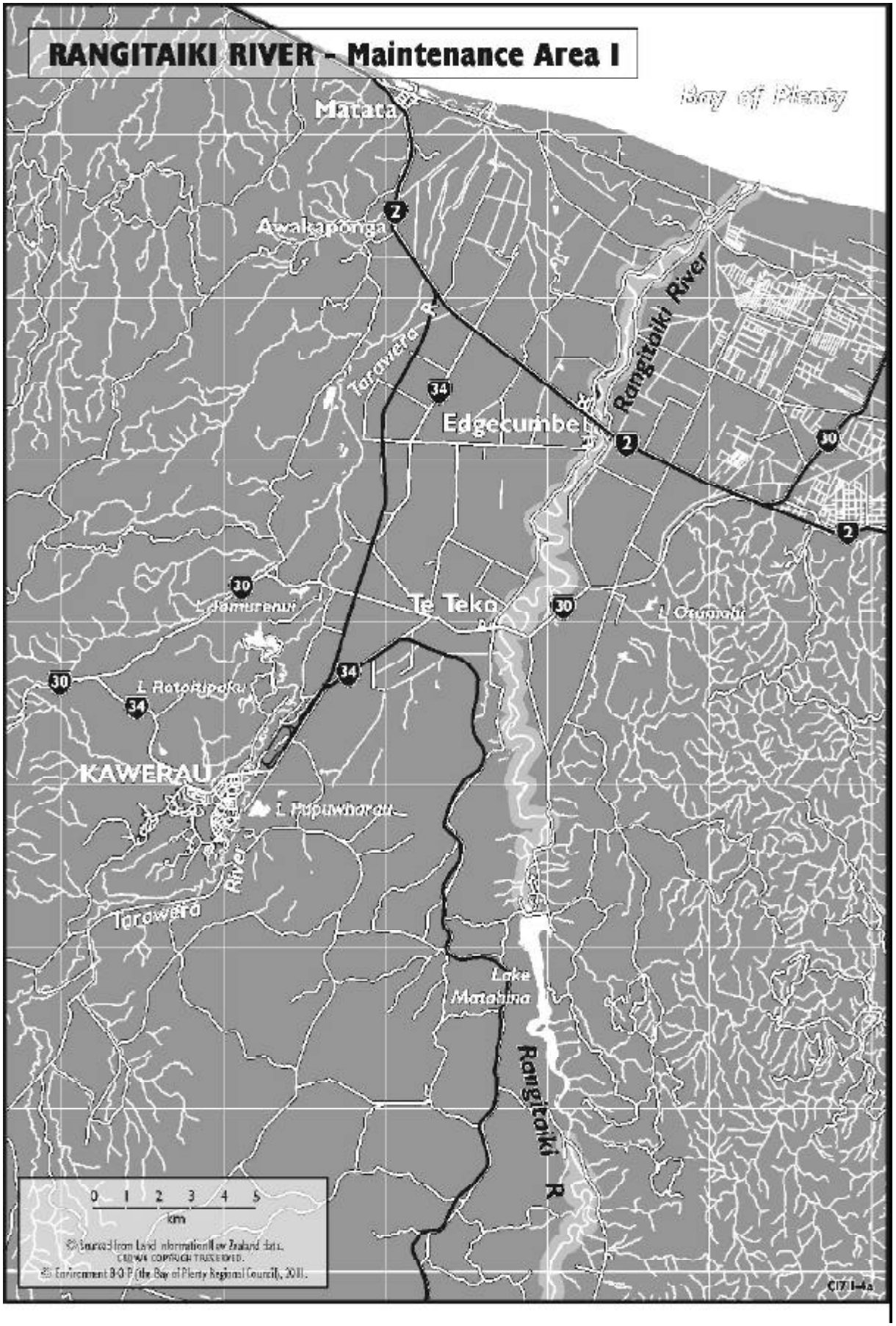

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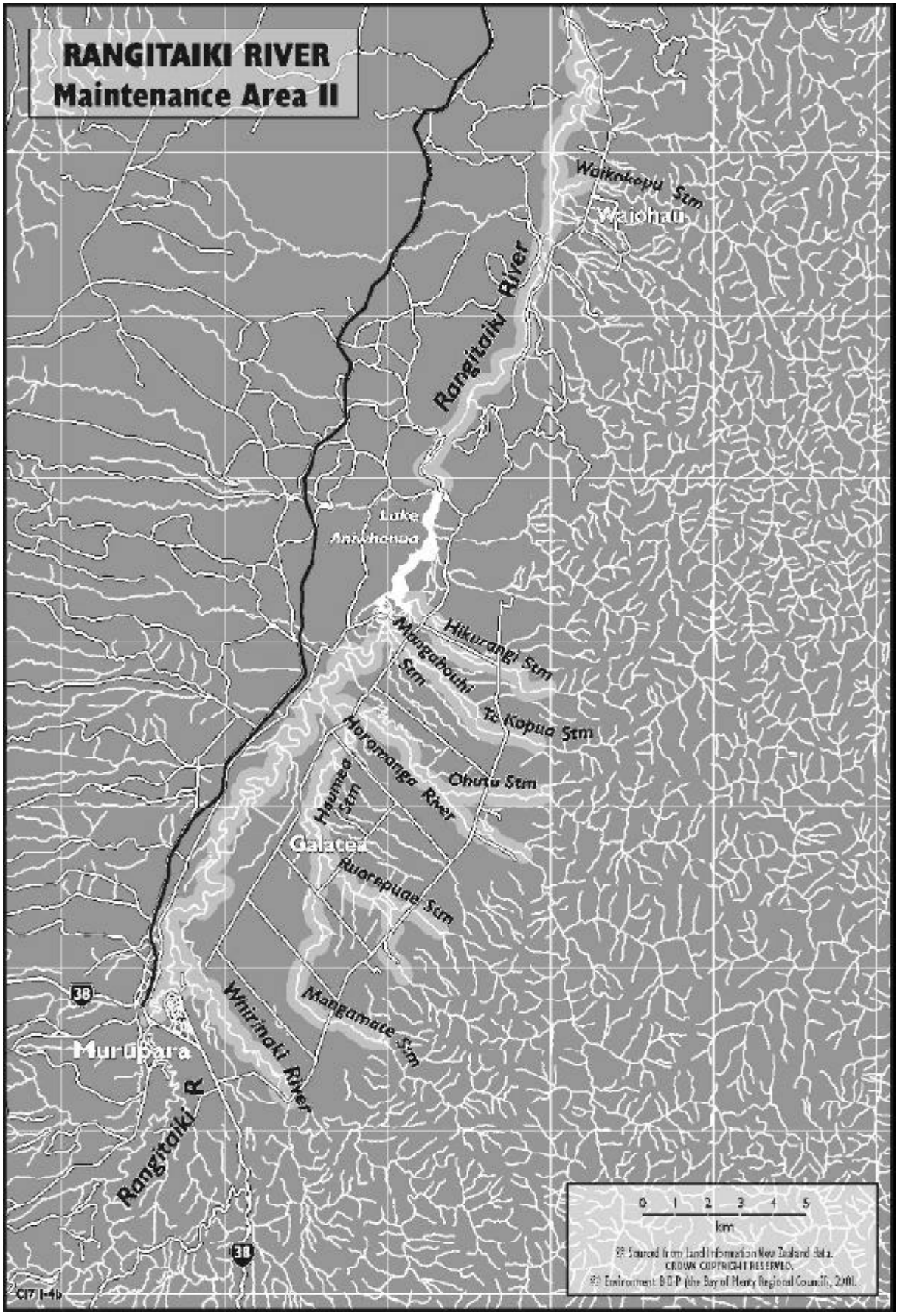

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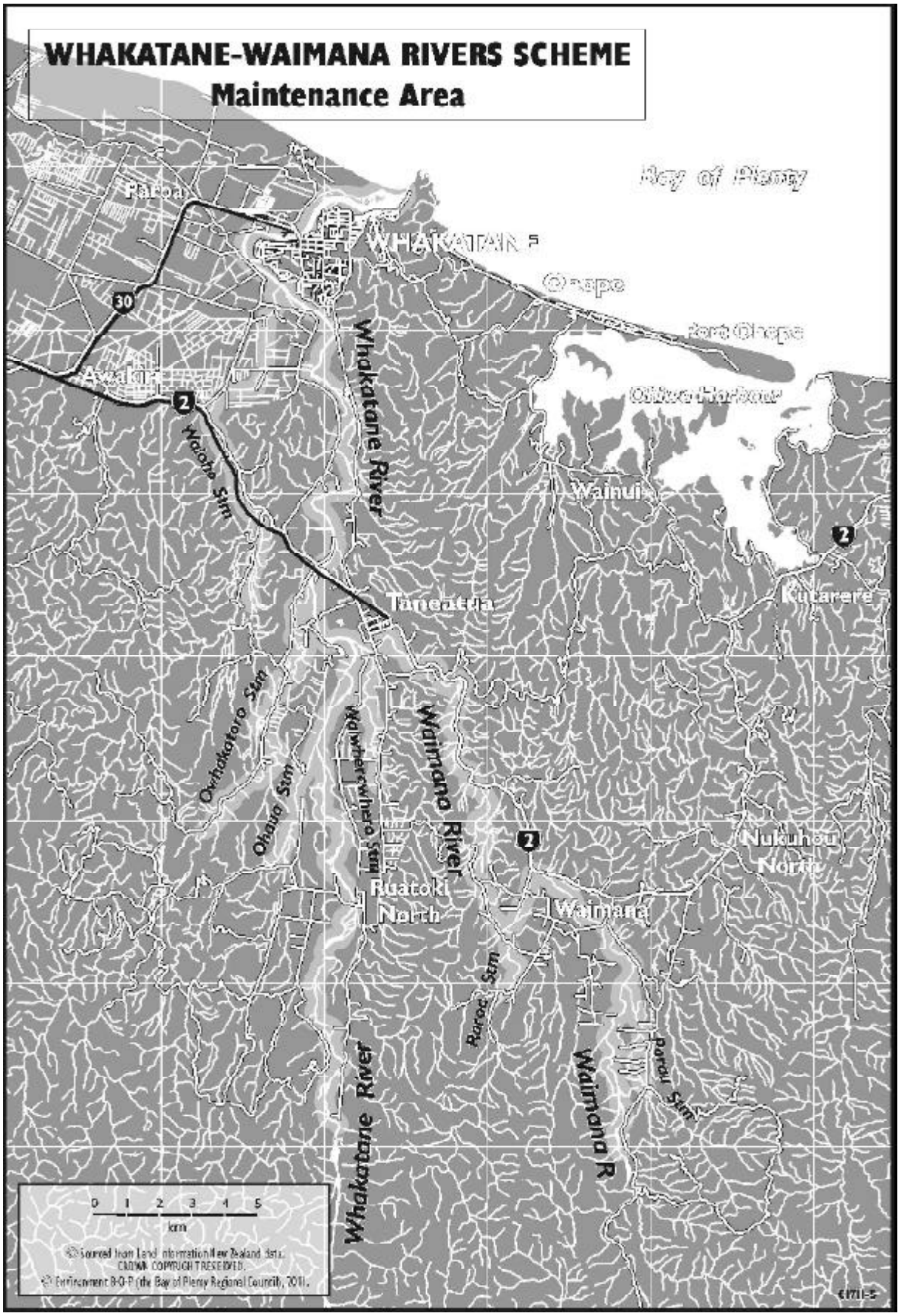

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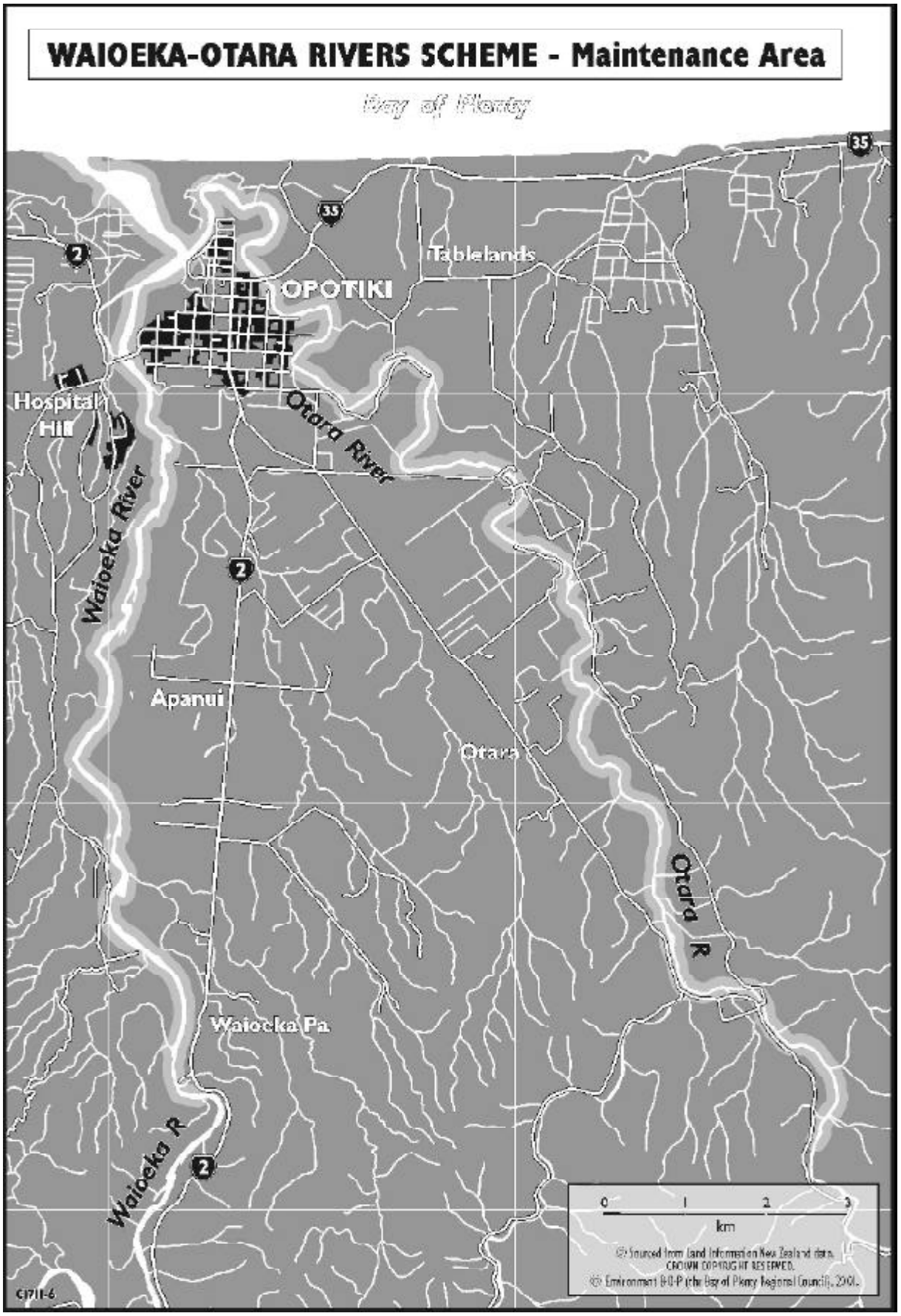

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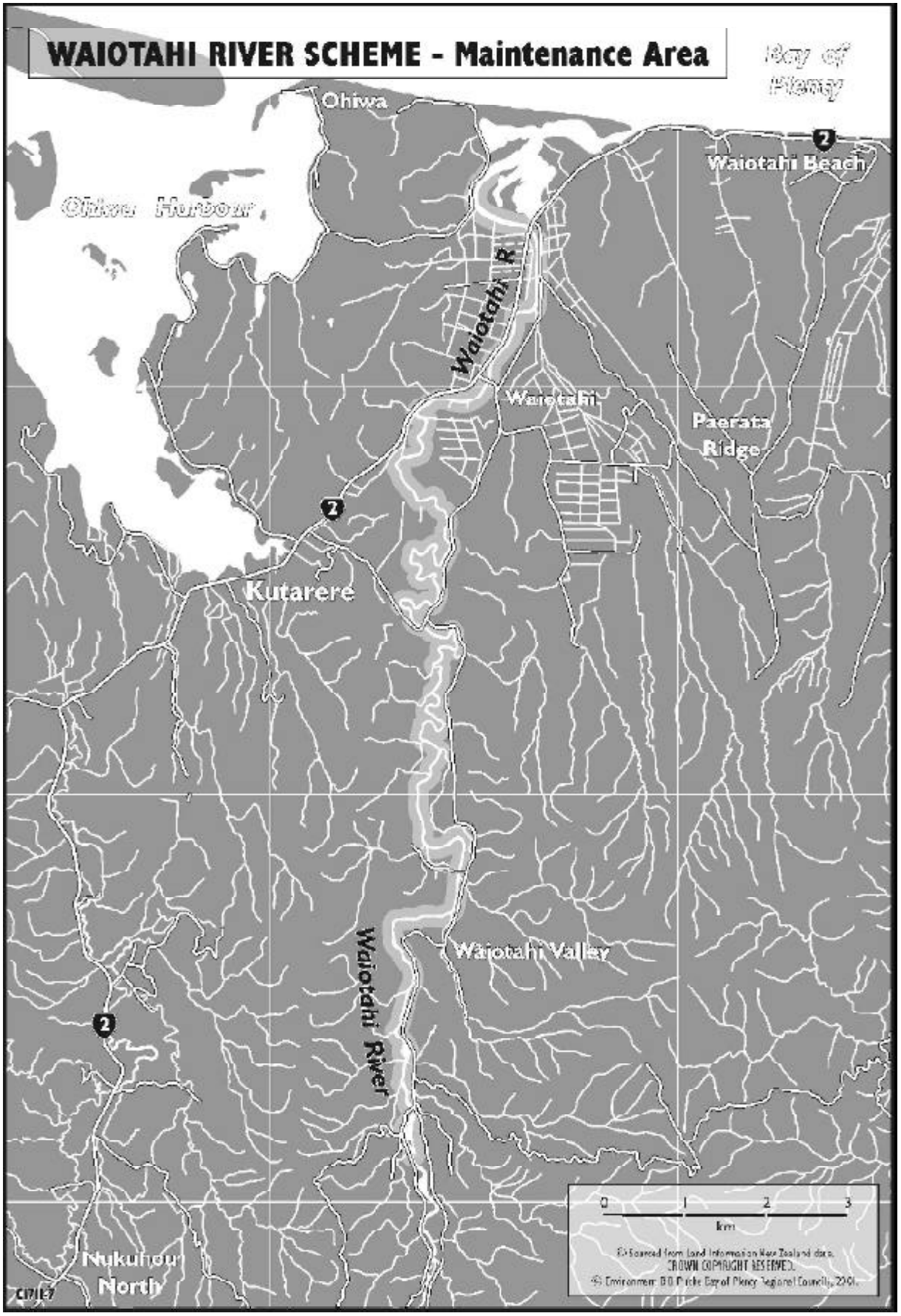

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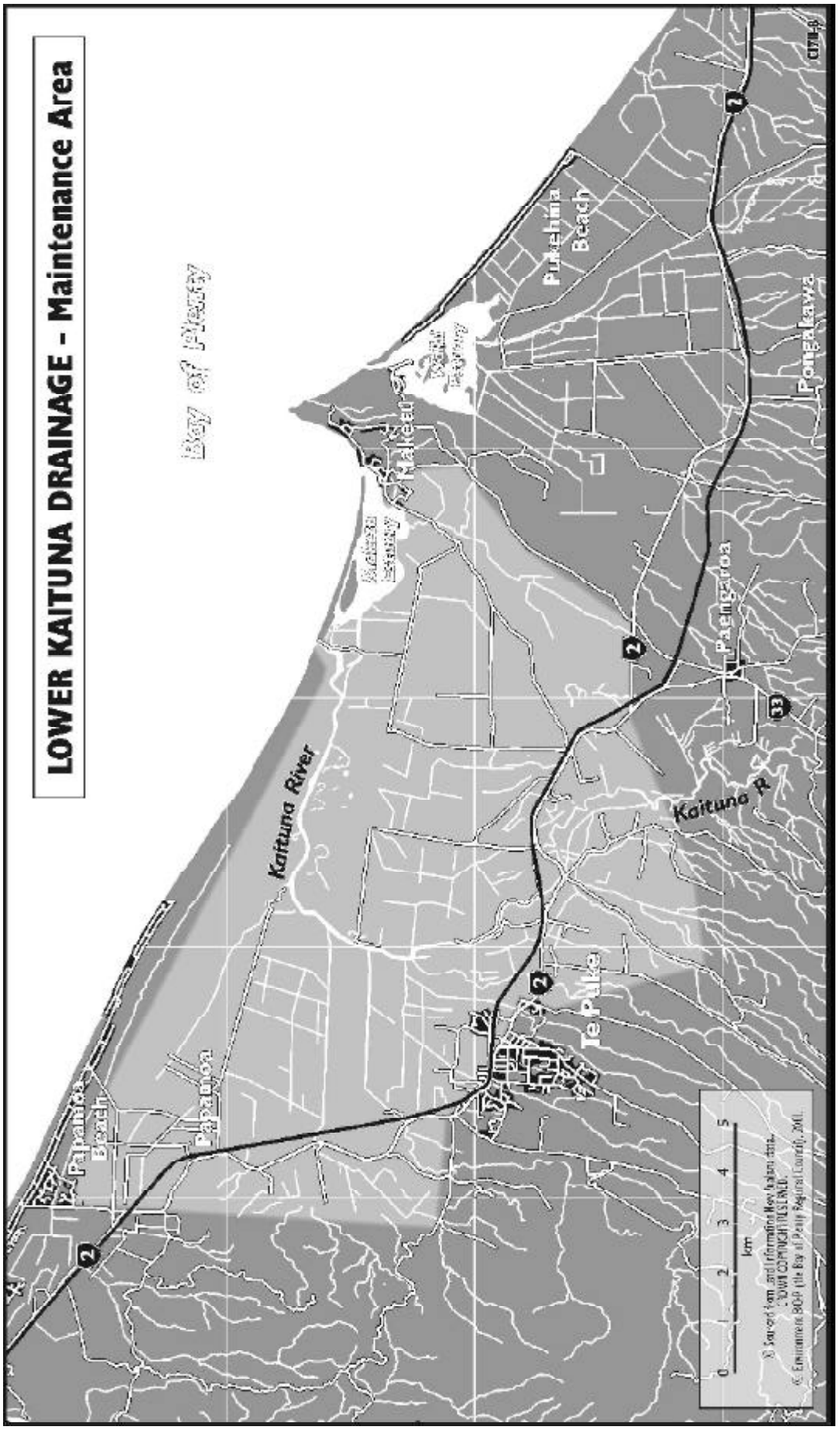

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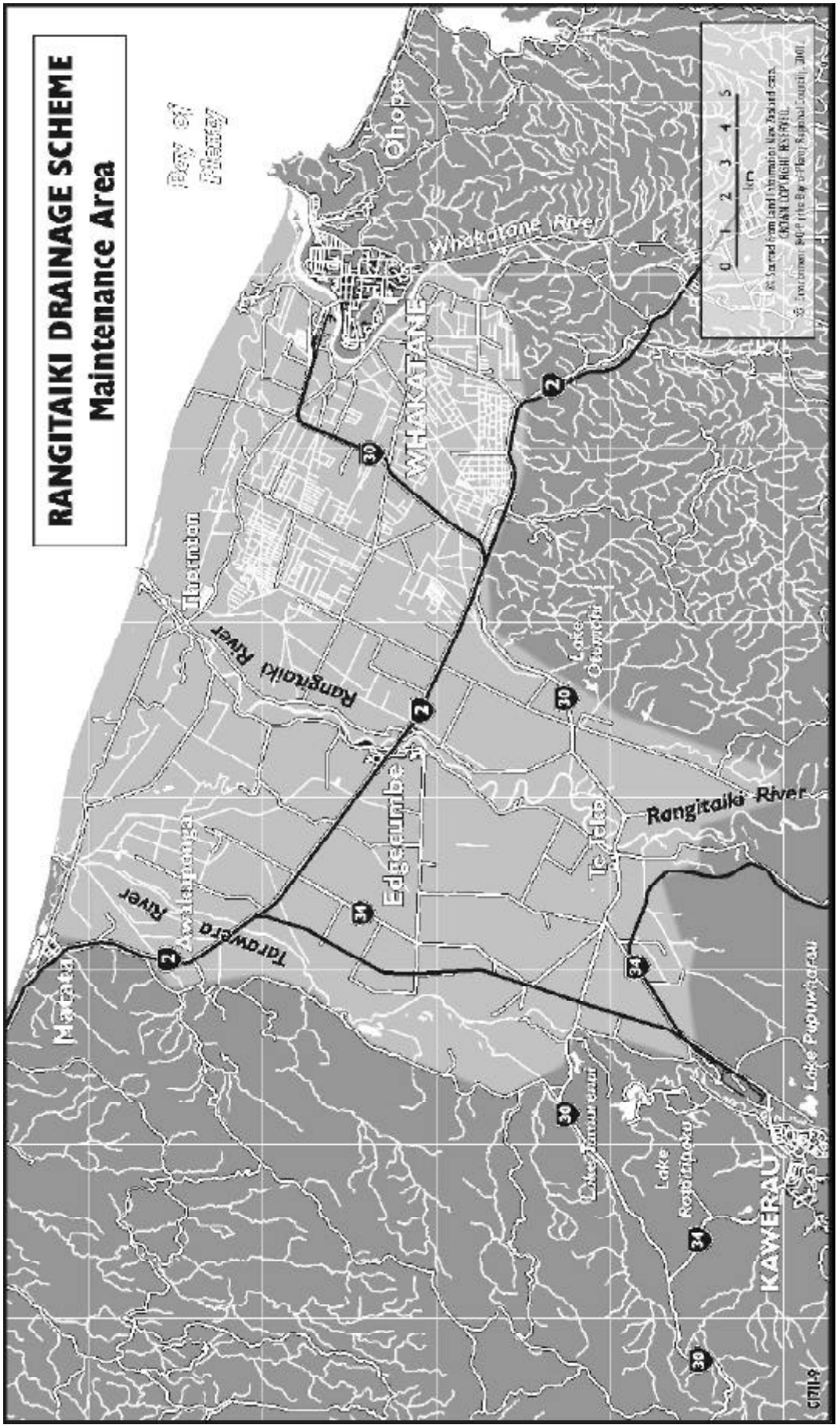

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