

Riparian Zone Management

Guideline

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Summary

This Guideline and the Planting Guide are practical manuals for use by landowners, developers, organisations and community groups who have decided or are required to retain, enhance or restore a riparian zone or zones.

The Guideline is aimed at voluntary and mandatory riparian management situations for both individual land owners and groups of land owners whether they are:

- rural: farmers, lifestyle blocks, greenfields developers, councils and/or others
- urban: private and/or company land owners, councils and/or others

The Guideline and Planting Guide set out a process that involves:

- clarifying land ownership and partnership issues
- defining the problem
- assessing existing vegetation and stream quality
- setting resource management objectives
- determining the width of the riparian zone
- preparing a planting plan and selecting and obtaining the right plants
- deciding when and how to plant
- inspection and maintenance, pests, weed and animal control
- monitoring and review of planting programme success

Training Courses on the Guideline and the Planting Guide have been developed for people wanting or likely to be involved in riparian zone enhancement, restoration or management.

The Auckland Regional Council's Regional Environmental Care Co-ordinator is available on 09 - 366 2000 to offer help and information on training courses.

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1.0 How to use this Guideline

1.1 Key concepts

Some important concepts to consider when preparing a planting plan for riparian management are:

1. Riparian management should always be evaluated in terms of the whole catchment. In most cases the proposed works will be specific to a reach of stream or river (possibly several kilometres long) or around a pond, wetland or lake.
2. When an individual landowner undertakes a voluntary planting programme, the planning and evaluation process can be simplified and a less detailed Planting Plan developed.
3. When the Guideline and Planting Guide are being used for statutory or more complex situations, a formally documented Planting Plan is necessary and desirable. These situations could include, for example, cases where:
 - there are several properties involved, perhaps in a Landcare group
 - there is a regulatory requirement for riparian management, for example as part of a subdivision or earthworks consent
 - the area involved is extensive, for example:
 - i. a long reach of stream of more than 500 metres
 - ii. an entire sub-catchment
 - iii. a whole catchment

The Auckland Regional Council provides training workshops for people wanting to know more about riparian zone management or who expect to become more involved with it. The workshops aim to promote a consistent approach to riparian management across the region and a high standard of establishment and maintenance of riparian zones. For more information contact the Regional Environmental Care Co-ordinator on 09 - 366 2000.

1.2 Starting tips

Tips for individual land owners:

The amount of effort you need to invest into assessing stream and vegetation quality, defining problems and objectives and the other tasks outlined in this Guideline depend on the scale and complexity of your proposal.

You have the simplest case, where as an individual

property owner, you are going to plant new riparian vegetation or protect and restore existing riparian vegetation.

You won't necessarily need to use all of the detailed procedures and field sheets. Common sense use of this Guideline and the Planting Guide should produce a rewarding outcome for you.

Tips for developers complying with consent conditions, many land owners working together or individuals working with very large land areas:

This Guideline sets out in detail the amount of information necessary to support the more detailed planting plans that are needed for compliance with a statutory requirement, or where many people or a large area are involved.

For you, the guiding principle is that riparian management is most effective on the sub-catchment and catchment scale, so you need to consider the whole catchment when planning to plant some sites within it. The level of information you need in your planting plan will be dictated by the extent of the land use change you propose.

For larger or more complex projects involving many landowners or major developments, also where compliance with resource consent conditions is required, more detailed planning and information gathering will be needed to meet the conditions of consent or the resource management objective.

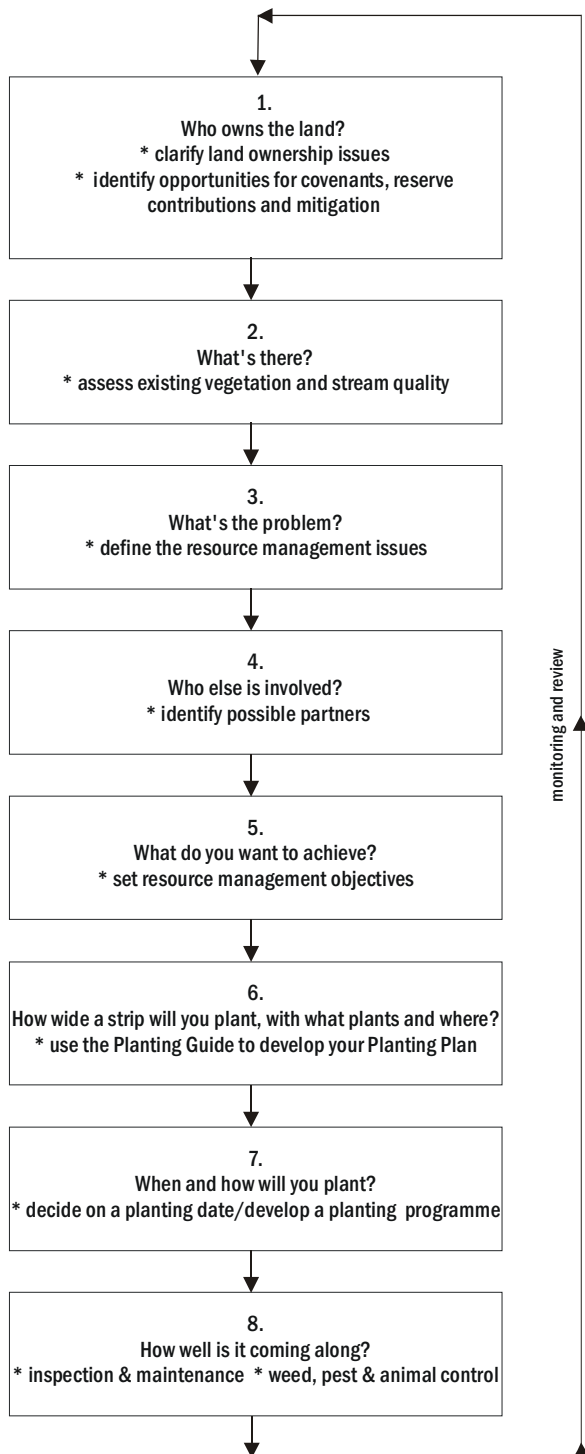
1.3 Working with others

Working with other people helps to maximise the ecological and amenity benefits of riparian zones.

Even if you are considering riparian zone management on your own land, you may want to consider working with other people, too, because:

- no matter how extensive your holding is, it is likely to form only part of a whole river catchment
- a small riparian area within a large catchment may not significantly benefit water quality and land and water habitat downstream, despite the very real benefits to you as an individual land owner. So, it may be an idea to encourage others to do it, too
- unless you own land on both sides of a stream or all around a lake, you will only be solving some of

Figure 1: Key steps in establishing and maintaining a riparian management zone



- your riparian zone will not be able on its own to solve all the problems of poor land and riparian management upstream of your property
- gains made by upstream land owners can easily be lost by poor land and riparian management further downstream

However, taking the lead can also be invaluable: if you are the first land owner in a catchment to carry out riparian zone management, you may be the start of an invaluable initiative as others follow suit.

- ➔ If in doubt, just start on your own land - others may follow your example!

1.4 Incentives and funding sources

Some limited incentives and funding sources are available for individual landowners and community groups to help with riparian management.

The Auckland Regional Council Environmental Initiatives Fund has been established to provide up to \$5,000 for a group undertaking an environmental project.

The Auckland Regional Council has a publication Funding Sources and Assistance for Community Groups Involved in Environmental Action in the Auckland Region.

- ➔ If you would like application forms and funding details or a free copy of the funding publication (RDC/ARC 2000), call the Auckland Regional Council Enviroline on 09 - 366 2070.

1.5 Using the Guideline

Use this Guideline following the steps outlined below.

1. Choose which of the following categories best suits your situation:
 - Rural land owner or developer: farmers, lifestyle blocks, greenfields developers, councils and/or others
 - Urban land owner or land owners: private and/or company land owners, councils and/or others
2. Read the flow chart in Figure 1, about key steps in preparing a planting plan for a riparian management zone

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3. Turn to the part of the Guideline that describes the management planning process for your situation and follow the steps outlined
 - rural areas: individual and multiple land owners ➔ Section 2
 - urban areas: individual and multiple landowners ➔ Section 3
4. If you would like any help, call the Auckland Regional Council on 09 – 366 2000 and ask for the Environmental Care Co-ordinator

2.0 Rural areas: Individual and multiple land owners

Use this process if you are a:

- Farmer or individual landowner undertaking a voluntary or mandatory programme
- Group of landowners undertaking a voluntary programme
- Developer complying with resource consent conditions or mitigating resource use
- Infrastructure provider complying with erosion, stormwater or mitigation controls
- Council park manager protecting, enhancing or restoring vegetation

2.1 Key steps in preparing a planting plan for a riparian management zone

The key steps in preparing a planting plan for a riparian management zone follow the steps in the flow diagram in Figure 1, as explained in more detail below.

1. Who owns the land?

Always establish details of land ownership and access to the riparian margin before starting to plan a riparian planting programme. Covenants, reserve contributions and mitigation requirements can all affect land ownership and land use.

In the case of a large development or works associated with infrastructure, then make sure you document the on-going maintenance needs of the programme and any monitoring requirements, if these are requirements of land ownership or resource consents.

In some cases it will be necessary to ensure that riparian management obligations are transferred to new owners

of the land. This can be achieved by registering the requirement on the title of the land.

- ➔ City and District Councils hold cadastral and rating data bases that provide land ownership details.

2 What's there?

For individuals and groups of landowners undertaking voluntary riparian management, the amount of information required is optional, and depends on the size of the project.

- ➔ You can get help with these information requirements and access to databases if you attend any of the Auckland Regional Council's Riparian Zone Management Training courses.

Use *Field Sheets 1* and *2* to determine stream type, quality, catchment size and general notes on changes in water level during storm events. This information is helpful for identifying flood plains and suitable vegetation for each planting unit.

Field Sheet 3 is used to assess existing vegetation. These sheets are at the back of the Guideline.

Basic recommended information needs are underlined in the check list below:

- Map (see vii below)
- Photographs
- Description of the:
 - physical characteristics of the site and catchment, such as area, landforms, existing values, see i) below.
 - geology, soil type, soil permeability class and soil infiltration rate
 - slopes and slope stability, especially of areas adjacent to streams with unstable geology and steep slopes, such as unconsolidated clay soils on slopes greater than 15%
 - vegetation and land use on the site and elsewhere in the catchment
 - hydrology: climate, especially rainfall, and stream flow, including floods
 - extent of the floodplain, see notes for Figure 2 and 3 in *Field Sheet 2* and Figure 3 in the Planting Guide, for a representative stream and channel cross section.
 - details of resource consents on the site and in the catchment

- ➔ The Auckland Regional Council has data bases for much of this information. Some are available:
- on the Council's website www.arc.govt.nz
 - from the Council's GIS section through Enviroline, 09 – 366 2070
 - through the Council's Information Research Centre on 09 – 379 4420

Additional data not found from these sources may be required for riparian zone planting plans for some larger and more complex cases.

Some of the information requirements are outlined in more detail below.

i) Physical characteristics

Describe the site and its catchment and show photographs and include information such as:

- area of site in hectares
- find the total area of the catchment in square kilometres (see *Field Sheet 2, Figures 2 and 3* for guidance)
- its general locality in the Region, from NZMS 260 series
- dominant landforms, such as flood plain, flat land, rolling, gentle-steep hill country
- existing natural values such as wetlands, existing ecology, riparian and terrestrial vegetation, soils and slopes

- ➔ In the case of subdivision and associated land use change, refer to the Auckland Regional Council's Technical Publication 124 (2000) for guidance on greenfields, subdivision site development and protection of natural features.

ii) Geology and soils

Describe the site and its catchment and include information such as:

- rock types
- soil types
- soil permeability
- soil infiltration rate

- ➔ Refer to soil maps 1:50,000 prepared by Landcare Research from the National Soils Database for ARC and the Soil Parent-Material Map – Auckland Region see Figure 3 Planting Guide.

iii) Slopes and stability

Describe the site and its catchment, including:

- slope group, from the Land Resource Inventory Classification (*Field Sheet 4*)
- slope angle and aspect (*Field Sheet 4* gives simple descriptions to help you estimate slope)
- slope stability, especially of areas adjacent to streams with unstable geology and steep slopes, such as unconsolidated clay soils on slopes greater than 15%

iv) Land Use and Vegetation

Describe the site and its catchment, including:

- a description of recent land use changes, or, if warranted in more complex cases, a comprehensive account of dominant land uses, including aerial and site photographs
- an assessment of the existing vegetation in both the catchment and on the site, using *Field Sheet 3* to assess riparian vegetation. This should include an assessment of the current incidence of plant and animal pests and the impact of upstream and downstream areas acting as a future source of reinfestation of plant pests

- ➔ District Plan maps include land zone and land use information. District Plans are held by ARC, the relevant District Council and public libraries.

Some convenient classes of riparian vegetation types (*Field Sheet 3*) include:

- native bush
- native shrub land
- native tree land
- exotic tree land
- exotic/native mix
- weed dominated
- pasture
- cropland
- display gardens
- no riparian vegetation: farmed to the stream edge

Some convenient classes of dominant land use in undeveloped and rural areas include:

- dairy and dry stock farming
- horticulture
- market gardens
- lifestyle blocks
- land zoned for future development

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v) *Hydrology*

Ideally, the riparian management plan should include information on the 100 year floodplain, subject to landowner agreement and relevance to the site (see the generalised cross section for Auckland streams in *Figure 4* of the Planting Guide).

Field Sheet 2 includes *Figure 2* and *3* they give the area of the Region's key catchments as well as some general information on the hydrology of streams and rivers in the region.

Describe the site and its catchment, including:

- climate, especially rainfall
- stream flow, including floods
- map of the extent of the floodplain
- map of non-tidal perennial streams on the site

Identify the stream type from the list below, using *Field Sheet 1* in this Guideline and Appendix 1 in the Planting Guide:

- the Kaipara and Awhitu sand dunes
- lowland clay and pumice catchments
- upland weathered rock catchments
- those that are predominantly rolling to gentle gradients with volcanic soils

Select a stream size and category from *Field Sheet 5* at the back of this guideline.

Identify existing stream quality from *Field Sheet 1*, for example:

- high: all or mainly native bush upstream
- medium: all or mainly pastoral and/or cropland upstream, with or without occasional native or exotic trees
- medium low: as above, but with discharges of rural wastes such as dairy sheds
- low: all or mainly residential and commercial development upstream
- very low: mainly industrial or significant industrial areas upstream

vi) *Land ownership and resource consents in the catchment*

Describe the site and its catchment, including:

- land ownership (see 1. above)
- location and volume of resource consents to:
 - take surface and ground water
 - discharge wastewater and other contaminants

- discharge stormwater to waterways, wetlands or detention ponds
- location and extent of resource consents to carry out earthworks and the location and size of any sediment retention or stormwater detention ponds

vii) *Map*

A map of the site's location in the catchment or subcatchment should be provided, and it should also show as much of the available information as possible.

A Geographical Information System (GIS) map with associated data files would be suitable for more complex cases, with the relevant data on geology, soil type, slope, stability, climate, hydrology, land use and resource consent data bases attached to the catchment GIS map.

➔ A good example of this type of mapping and associated data bases is on CD GIS Hydro'99, compiled by ESRI and held by the Auckland Regional Council's GIS section. Further information is available on www.esri.com.

3 *What's the problem?*

Use the first three columns in *Field Sheet 6* to assess existing resource management issues in the stream, in the riparian zone and in the wider terrestrial environment, then score them from low to high.

Where any other resource management issues or problems are known, these should also be discussed.

4 *Who else is involved?*

Identify upstream and downstream landowners and those across the stream in order to identify who is willing to share the costs and provide resources for the riparian programme.

Where riparian management is part of a development or infrastructure project, then the riparian zone management programme may be a requirement imposed by conditions of a resource consent. The grantee then has the option of carrying out the works or contracting out to a suitably qualified agent.

5 *What do you want to achieve? Identifying risks and benefits*

Use the last two columns in *Field Sheet 6* to identify the primary and secondary resource management objectives for riparian management.

Use *Field Sheet 7*, management options for identified resource management issues, to identify solutions to the identified problems.

Any other resource management objectives should also be discussed.

Identify benefits and risks, using the prompt list below, which applies to all forms of riparian zone management in rural and urban catchments (see also Table 2 in the Strategy):

Benefits

Riparian management successfully treats many resource management problems. Potential resource management problems that benefit in the long term from sustainable riparian zones include:

- improves stream channel stability
- reduces water temperatures
- improves dissolved oxygen levels in the water
- reduces aquatic vegetation
- decreases suspended solids in the water, after banks have stabilised
- increases water clarity
- reduces nutrient enrichment from fertiliser runoff or animal waste
- increases carbon inputs to stream from inadequate riparian vegetation
- improves habitat diversity on banks and within the stream - that is, provides a range of different plant types and instream cover such as logs, branches, boulders, stones or pebbles
- improves terrestrial habitat diversity in the catchment as a whole - that is, the range of different plant types or types of groupings of different plants

Risks

However, there are risks associated with riparian management, including:

- the planting of flood plains can increase local ponding and flood levels
- canopy planting will have less effect on flood flows but can increase stream bank instability
- shading will result in decreased in-stream uptake of nutrients by macrophytes and lead to increased nutrient yields and eutrophication in estuaries
- until new shade-tolerant riparian vegetation has established, shading of grasses on stream banks will initially cause erosion and channel widening and lead to short to medium term sedimentation and associated ecological effects in streams estuaries
- channel widening could result in loss of riparian planting
- public access to riparian zones can be difficult to plan without compromising their effectiveness, for example, a pathway segmenting a riparian zone can cause loss of ecological benefits
- planted areas can raise safety issues if there is concern about people using them for concealment
- in rural areas, restricting stock access to streams for drinking water (a benefit to the stream) is a cost to the farmer, who must provide an alternative water source
- flood control in farm drains is often achieved by regular mechanical 'cleaning'. This damages aquatic habitat and the sustainability of riparian buffer zones
- riparian planting can provide habitat for weeds and animal pests, willows in particular will provide seasonal food for possums and other plantings may provide nesting for possums, rabbits, hares and mustelids (weasels, stoats and ferrets)

You will need to check for the likelihood of such risks before developing your Planting Plan. ARC have commissioned further investigations into risks associated with nutrients and sediments. New information will be in updated versions of the Strategy and Guideline.

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6 *What will you plant, and where?*

Use the information from the Field Sheets at the back of this Guideline and the Planting Guide to prepare a Planting Plan.

The riparian zone to be planted should include riparian areas of known slope instability, unstable geology or steep slopes, for example unconsolidated clay soils on slopes greater than 15%, regardless of areal extent, but subject to the agreement of the landowner (ARC TP 71, June 1996, has more information about this)

It is important to plant vegetation that is appropriate for the resource management problem identified on Field Sheet 7, while the width of a sustainable riparian zone is discussed in Section 2 of the Strategy.

7 *When and how will you plant?*

Use the Planting Guide to plan the best time of year to plant and identify how long it will take to establish the planting.

The Planting Guide will also help you to identify:

- what is growing on site now and what used to grow there
- what native plants are appropriate
- plant tolerances, for example to shade, sun, damp and so on
- plant size at maturity
- type of planting that will meet the identified resource management objectives
- extent of plant maintenance and weed and pest control necessary to ensure success of the programme

8 *How well is it coming along?*

Regularly inspect the planting and carry out weed and pest control, in order to assess plant health and progress towards meeting your resource management objectives.

The ARC's plant and animal pest management strategies name a number of plants and animals as pests and include a range of management options for them. These include the Council carrying out control of plants of limited distribution, control of possums and goats in high conservation areas, requiring land occupiers to control certain widespread plants and the provision of information and advice on plant and animal pest management techniques. Not all weeds are included in the Regional Plant Pest Management Strategy (list of

weeds in Appendix II, Planting Guide), but the Biosecurity Unit can provide advice and information if requested.

➔ The ARC's Biosecurity Unit can provide the following help with the restoration of riparian zones:

- information and advice on weed and plant and animal pest management techniques
- identification of weeds and plant pests and advice on suitable control techniques
- identification of sites of "Service Delivery Plant Pests" where serious plant pests are present

9 *Monitoring and review*

Annual inspections of representative riparian plantings will be conducted by the Auckland Regional Council.

➔ If you would like any help or advice, contact the ARC's Environmental Care Co-ordinator on 09 – 366 2000.

3.0 Urban areas: Individual and multiple landowners

Use this process if you are representing a group of:

- Private land owners
- Company land owners
- Councils and/or other organisations

3.1 Special considerations for urban areas

Urban areas pose special challenges for riparian management because streams may be affected by building to the water's edge, stormwater inputs and piping or lining with concrete. However, some councils and infrastructure organisations are setting priorities for stream enhancement and restoration (daylighting) as part of comprehensive upgrades of sewerage and stormwater infrastructure.

Some constraints on riparian management programmes in urban areas include:

- access to the riparian margin is often more restricted by private property rights
- there are greater risks to public safety and security issues in riparian zones
- stormwater quality ponds are included in many new developments and may be considered a safety risk to young children

- it is more difficult to take a catchment-wide view of riparian management because of the many different landowners and other interested parties
- ➔ If you are interested in working with others in a 'Care' group to restore an urban stream to a more natural state, contact your local council or the ARC's Environmental Care Co-ordinator on 09 – 366 2000.

3.2 The process

The process to follow is essentially the same as outlined in section 2 of this Guideline, namely:

1. **Who owns the land?**
2. **What's there?**
Field Sheets 1, 2 and 3.
3. **What's the problem?**
Use the first three columns in *Field Sheet 6*.
4. **Who else is involved?**
Identify upstream and downstream land owners and those across the stream, as well as other organisations such as councils and providers of infrastructure such as stormwater systems.
5. **What do you want to achieve? Identifying risks and benefits**
Use the last two columns in *Field Sheet 6* and *Field Sheet 7*.
6. **What will you plant, and where?**
Prepare a Planting Plan, using the information you have gathered and the Planting Guide a companion document to this Guideline.
7. **When and how will you plant?**
Use the Planting Guide to plan the best time of year to plant and identify how long it will take, and whether you will need any voluntary or contracted help.
8. **How well is it coming along?**
Regularly inspect the planting and carry out weed and pest control, plant health and progress towards meeting your resource management objectives.
9. **Monitoring and review**
Annual inspection by the Auckland Regional Council may be arranged, along with advice and help offered as needed.

4.0 Case Studies

Individual landowners that volunteer to protect, enhance or restore riparian vegetation where no land use change is proposed will be able to select basic information requirements from those set out in Figure 1, the flow diagram on preparing a planting plan for a riparian management zone.

If the owner of the property is planning a land use change then additional information on covenants, reserve contributions and mitigation should be recorded. Otherwise the voluntary participant should follow the key steps in Figure 1 and section 2.

We encourage a common sense approach to riparian management, at the same time remembering that the individual is part of a catchment and the large scale effects of riparian management are best understood at a catchment scale.

This section outlines 6 types of case study:

- single land owners in a rural area
- many land owners in a rural area
- individual land owners in an urban setting
- many land owners in an urban setting
- riparian zone management as a requirement of subdivisional and earthworks consents
- case studies of riparian planting in several ARC Regional Parks

4.1 Case Study 1: Single land owners in a rural area

The case study below outlines an initiative by a pair of individual landowners that began by fencing the streams and bush lots on the property and then carrying out weed and pest control combined with self generated native plants and trees. It has resulted in a fine example of riparian restoration.

Derek and Primrose Williamson, Mangemangeroa valley near Whitford.

This 40 ha property was purchased by the Williamson family around 1950 and was a dairy and pig farm up to the late 1980's, since when dry stock and horses have been farmed. The owners have fenced the riparian margins and bush lots on this property with a combination of 7-wire post and batten and 2 wire electric fences with 2 plain wire fences. Derek Williamson says the electric fences are

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a good option in unstable country as they are easy to repair or replace if the land moves.

There is a nursery area on the property where a wide range of self-sown native plants are grown on and then transplanted to retired areas and riparian margins on the farm. There is ongoing weed and possum control, and the value of this is obvious from the health and vigour of the bush lots and riparian vegetation on the property.

This is an excellent example of a voluntary riparian restoration project carried out by one landowner. The Williamsons offered several comments arising from their experience with protection and restoration of vegetation:

- regulators could offer incentives to landowners to fence off bush lots and riparian margins for protection of existing vegetation or restoration purposes
- regulators could provide information on plant species and the reasons why natives are preferred to some exotics
- weed control and disposal is essential to creating sustainable riparian vegetation
- the width of a riparian margin is often determined by the landform, especially where it is practical to put up a fence
- on many properties, fencing off the stream will require an alternative stock water supply, and some financial assistance would be helpful

4.2 Case Study 2: Many land owners in a rural area

This case study is based on a catchment management plan for the Wairoa River in preparation by ARC. The plan is supported by the Wairoa River Catchment Riparian Margins Inventory and Issues Assessment prepared by Boffa Miskell Ltd (1999) and a number of other technical reports addressing specific resource management issues.

Resource management objectives

Two of the objectives from the Wairoa River Catchment Management Plan are to:

- protect, enhance and restore riparian vegetation in the Wairoa River catchment
- select the most effective riparian management options for the Wairoa River catchment based on data from the above inventory

1 *Land Ownership*

In the case of multiple landowners or where the land use change is extensive and complex then riparian management and maintenance should be recorded on the property title to ensure on-going commitment to the programme.

Details of land ownership in the Wairoa catchment were found on the Manukau City and Franklin District Council cadastral and rating databases.

2 *What's there?*

- (i) Physical characteristics
 - area of individual sites and total length of stream proposed for riparian management area of catchment or subcatchment where the sites are located, estimated from *Field Sheet 2* and *Figure 3*.
 - locality in region, map reference from NZMS 260 sheets R11, S11, S12
 - natural values from the Auckland Regional Policy Statement Chapters 6 Heritage and chapter 18 Esplanade Reserves and Strips, sourced from ARC Envirolineon 09 – 366 2070
- (ii) Geology and soils
 - Landcare (1999) report has information on geology, and soils, available from ARC Information Research Centre, 09 – 379 4420.
- (iii) Slopes and stability
 - Landcare (1999) report, p54 and Appendix 1
 - the New Zealand Land Resource Inventory Classification has details on slope and aspect and is available from the ARC Information Research Centre on 09 - 379 4420
 - NZLRI provides a simple method for on site inspection of slope stability. (see Planning Sheet 4). Landowners should map slopes >15%
- (iv) Land Use and Vegetation
 - Landcare (1999) report
 - Colour aerial photographs available for viewing at the ARC. You can arrange an appointment through Enviroline on 09 - 366 2070
 - Boffa Miskell Ltd (1999) Land cover, vegetation types, physical habitat and assessment of riparian cover, available for viewing through ARC Information Research Centre, 09 – 379 4420

- (v) Hydrology
- Auckland Regional Council hydrology database, enquires to Enviroline 09 –366 2070
 - Map extent of floodplains on the relevant properties
 - Describe stream and channel cross sections from *Field Sheet 1* and *Figure 4* of the Planting Guide
 - Show width of proposed riparian zone, 10 - 20m either side of the stream is necessary for sustainable riparian vegetation (see section 2 of the Strategy)
 - Use the NZMS 260 series map to show the perennial streams of the catchment and validate the amount and quality of existing riparian vegetation in the Boffa Miskell Ltd (1999) report
 - Then refer to the Landcare (1999) report for guidance and *Field Sheet 1*, to determine the categories of stream in the catchment from the following :
 - sandy soils,
 - alluvial soils,
 - clay soils,
 - volcanic substrates.
 - complete *Field Sheet 5*, stream size and category, from site visit
 - identify existing stream quality from Landcare (1999) and Boffa Miskell Ltd (1999) reports as well as from a site visit and *Field Sheet 1*
- (vi) Locate resource consents on the map from Auckland Regional Council database, contact Enviroline 09 - 366 2070

3 **What's the problem?**

- use *Field Sheet 6* (site visit) with the Landcare (1999) and Boffa Miskell Ltd (1999) reports to assess resource management problems. Use *Field Sheet 2* and *Figure 2* to assess relevant hydrological information. Look at the last two columns on *Field Sheet 6* to relate resource management problems to management options and complete *Field Sheet 7*.

4 **Who else is involved?**

Discuss your plan with neighbouring properties.

5. **What do you want to achieve?**

- use *Field Sheet 6* to identify goals
- consult the Landcare (1999) and Boffa Miskell Ltd (1999) reports

6. **What will you plant and where?**

- use the Field Sheets and the Planting Guide to prepare a Planting Plan. A voluntary individual landowner is not required to prepare a planting plan, however, working through the steps outlined above will contribute to their appreciation of the wider catchment benefits of riparian management
- in the case of multiple owners and large projects preparing a planting plan is an essential step in achieving effective riparian management

7. **When and how will you plant?**

- consult the Planting Guide

8. **How well is it coming on?**

- follow the plant maintenance and pest control section of the Planting Guide

9. **Monitor and review.**

- As in your Planting Plan

4.3 Case Study 3: individual land owners in an urban setting

The Waterway Enhancement Programme was established by Christchurch City Council (Couling et al, 1998) as part of an ongoing commitment towards sustainable management of tributary waterways throughout the City. Enhancement activities involve landscaping to emphasise the natural contours of the waterways, and planting native species to promote the establishment and maintenance of aquatic and bird life. Waterway enhancement activities provide increased opportunities for recreation and education, as well as drainage, water quality and habitat improvement for the city. To the extent that they improve the habitat for native flora and fauna, they also contribute to a valuable natural ecosystem that contributes to the quality of life for all Christchurch residents.

The public good aspects of these benefits raise interesting policy questions regarding willingness to pay for waterway enhancement services, and the role of the public sector in their provision. In a study carried out by Lincoln University (Bicknell and Gan, 1998) a simple statistical model is specified and used to explore the relationship between property values and the proximity to a particular waterway enhancement site. The study

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showed a link between property values and waterway enhancement services. In particular an attractively enhanced waterway has a significantly positive impact on property prices (houses and vacant lots) in a north-eastern suburb of Christchurch. In this case the *individual owner* is benefiting from a publicly funded programme, and the individual has demonstrated a willingness to pay a premium for a vacant lot with proximity to the waterways enhancement programme.

4.4 Case Study 4: many land owners in an urban setting

The Kaipatiki Ecological Restoration Project on Auckland's North Shore started work in 1997 on a recreational reserve that was very neglected and undervalued. The aim of this restoration project is to restore Kaipatiki creek and its margins to their natural ecology by looking after native plants, insects, birds, marine and freshwater life.

This is a very successful urban project. The reserve is public land, however, there are many private properties adjacent to it. The project has successfully:

- recruited many volunteers
- raised public awareness of the natural heritage values of Kaipatiki creek
- educated people in sustainable land management
- carried out restoration of vegetation and wildlife habitat
- propagated their own native plants
- constructed 1 km of public pathway in native bush
- provided guidance and input to nearby road construction
- assisted with stormwater management
- demonstrated long-term commitment to this restoration project

The project coordinators release a monthly newsletter that goes to 6000 recipients, they organise open days and guided walks and have been very successful at obtaining funds from a wide variety of sources. More information about this project can be obtained from their web site www.kaipatiki.org.nz.

4.5 Case Study 5: Riparian zone management as a requirement of subdivisional and earthworks consents

The Kerrikan Block is a 30 hectare property located on an unnamed tributary of the Lucas Creek at Albany. The first stage of development involves, among other works, undertaking works in watercourses and a riparian management strategy is a condition of the resource consent. A planting programme has been produced with the aim of reducing the effects of runoff to the stream and in time provide shade to reduce water temperatures and increase food supply to the stream.

Cattle have been excluded and the developer has planted around 300m along one side of the stream, eventually there will be approximately 1 km of planting on both sides of the stream. When the development is completed over the next 5 years the riparian vegetation will link to existing reserve walkways.

It is important that a weed and pest maintenance programme and monitoring be in place to ensure the success of the programme. Ideally the responsibility for maintenance and monitoring would transfer to the new property owners however in this case the stream margins will become council reserve.

4.6 Case Study 6: ARC Regional Parks

1. Tawharanui Regional Park

Near the campground is a wetland restoration that has been running since 1996. In pre human times this would have been a kahikatea swamp, but this was cleared, and despite being drained and developed into pasture, remained excessively wet during winter. Restoration plantings consisting of manuka, kanuka, cabbage trees and flax up to 4 years old can be seen along the riparian margins. In the 4 year-old plantings, the manuka/kanuka canopies have already coalesced, shading out most weeds, and a deep litter layer is forming on the ground. Elsewhere in the park, there are hillside and valley plantings of manuka and kanuka, and the older plantings, dating from the early 1990's, are forming dense shrublands, which are suppressing the growth of kikuyu grass.

2 *Shakespear Regional Park*

The park has a number of good examples of riparian plantings, some of them up to 25 years old. As one enters the park, there is a narrow mixed planting along a small watercourse on the northern side of the main entrance road. This planting dating from about 1975, and contains species such as manuka, broad leaf, kauri, rimu, kanuka, cabbage tree, karo, kohuhu, mamaku and ponga. Although the total width of this planting is only about 15m, the trees form good shade over the stream, and a dense sward of native grass *Microlaena* has established along the banks of the stream, along with various native shrubs such as kawakawa and mapou. The watercourse has cut down to form a narrow bed, which is well stabilised by the root masses of trees, tree ferns and grasses. This planting already forms good habitat for native birds, such as kereru and tui, which in turn are already bringing in seeds from other native remnant forest stands elsewhere on the park.

East of the campground in Shakespear Regional Park is a swampy gully with tributaries running northwards to the centre of the park and eastward towards Tiritiri Channel. The entire gully system has been fenced. A major branch contains Kowhai Glen, a remnant stand of taraire and puriri, with margins of younger manuka and kanuka. Other branches contain 10-20 metre wide riparian plantings of manuka and kanuka up to 7 years old. The older plantings are now 3m tall and the canopies have merged to form dense shrublands. Seedlings of kawakawa and karamu are becoming established in shaded litter layer beneath.

Along the lower reaches of the same stream, extensive raupo/sedge wetlands have become established naturally. A short distance from the point where this wetland enters the sea, an area of 25 year old plantings shades the stream, and the streambed is open and clear of invasive aquatic plants.

The plantings at Shakespear Regional Park, in addition to their important riparian roles, function as linkages between existing forest remnants, and provide habitat for birds making landfall from Tiritiri Matangi Island. Bellbirds and red-crowned kakariki are now regular visitors to the park from Tiritiri Matangi, and bellbirds have bred at Shakespear.

3 *Awhitu Regional Park*

This park has two extensive wetland restoration projects, and other riparian plantings. The first plantings were undertaken about 30 years ago, so Awhitu is a good place to see what can be achieved when plantings approach maturity. In the wetland, there are extensive areas of planted manuka and kanuka of various ages between one and ten years. Near the foreshore in the wetland south of the Brooke Homestead, one can see manuka and kanuka which were planted in 1998 and 1999. In the 1998 planting, the manuka and kanuka are already 2 metres high. In the wetland is a very good example of kahikatea planting: many of the trees are between 20 and 30 years old and some are approaching 10 metres tall. This kahikatea planting grades into saltmarsh ribbonwood communities and the whole appearance of the various plant communities looks very natural. These plantings also form valuable habitat for a significant fernbird population in this wetland, and buffer the area from surrounding pastureland.

In the golf course of the Awhitu Regional Park is a very good demonstration of the "before" and "after" of riparian planting. Just outside the park boundary on the neighbouring farm, the stream runs down a pugged watercourse through open pasture and rushes. At the park boundary the riparian planting begins. It is 20 metres wide in total and consists of c25-30 year old natives between 7 and 10 metres tall. The planting includes kauri, kahikatea, rimu, kawaka, kanuka, titoki, tarata, broadleaf, puriri, flax and cabbage tree. Some of the puriri have reached an impressive size in just over 25 years, including one specimen with a trunk circumference of just over 2 metres. Inside the planting, the shade has suppressed most weed growth, with the only current weed control being occasional removal of seedlings of woolly nightshade. The stream has changed its form quite noticeably, having cut down into a distinct watercourse with banks stabilised by masses of tree roots. Various native seedlings are becoming established in the understory. These will have an important role in the future by eventually replacing the canopy trees and allowing the planting to become fully self-sustaining.

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Field Sheet 1: Categories of Auckland streams

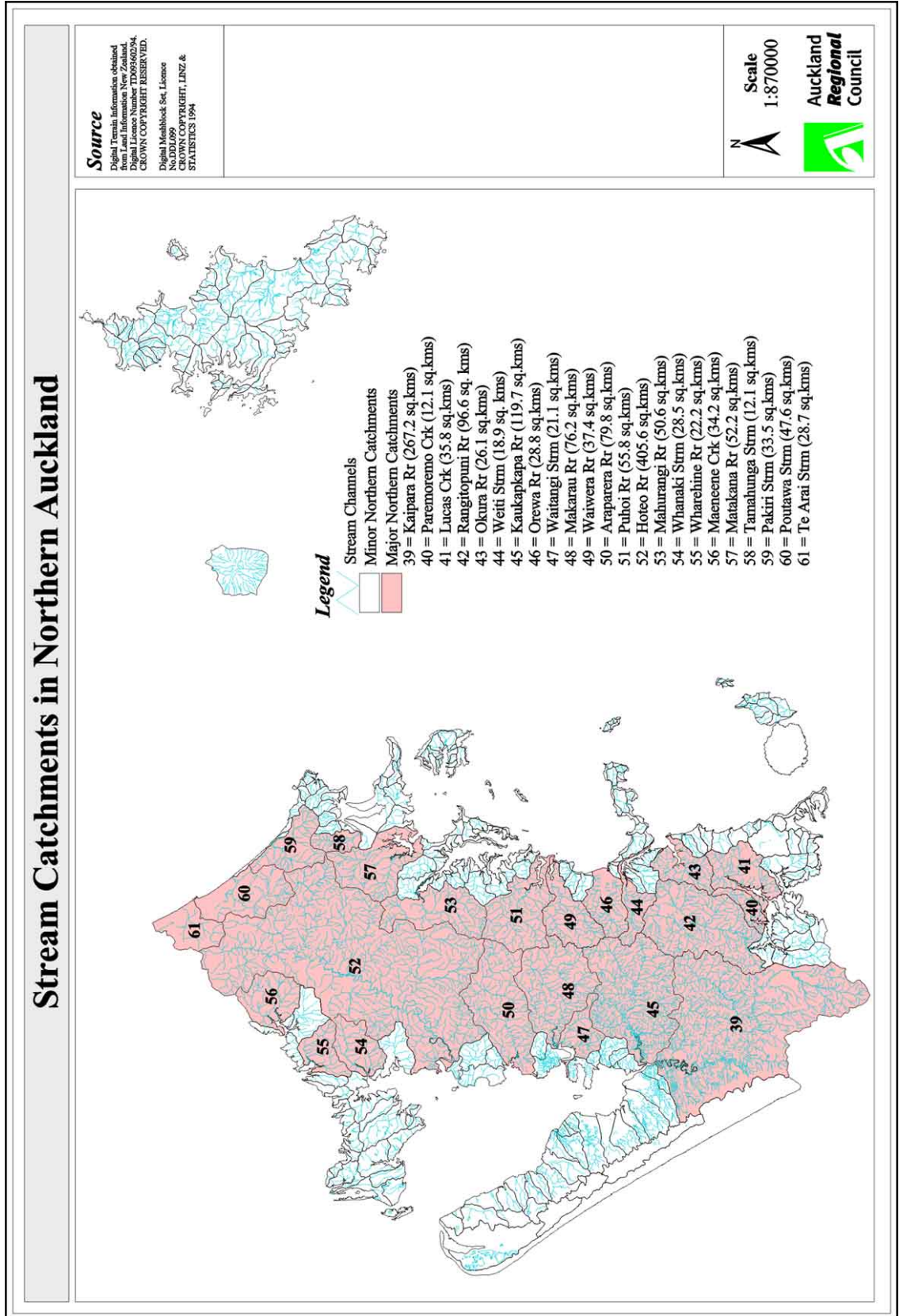
A Sandy Soils Streams in Sand Dunes	B Alluvial Soils Lowland Streams in Clay & Pumice Soils	C Clay Soils Upland Streams In Waitemata, Waitakere & Hunua rocks	D Volcanic Substrates Streams in Volcanic Substrates
Main water source	Overland flow and groundwater	Overland flow and groundwater	Groundwater and springs. High base flows, low water temperatures at source
Groundwater. Common to find low water temperatures at source	Overland flow and groundwater	Overland flow and groundwater	Groundwater and springs. High base flows, low water temperatures at source
Key characteristics	Overland flow and groundwater	Overland flow and groundwater	Groundwater and springs. High base flows, low water temperatures at source
Wetlands, natural and modified, small lakes and spring fed streams	Low gradient streams on floodplains, low velocities, naturally meandering, stream-bank erosion. Clay soils in north and pumice soils in the south of the region	Steep catchments. Weathered rocks and clay	Franklin area: old, deep soil horizons, more likely to erode than other volcanic rocks
Locality examples	Low gradient streams on floodplains, low velocities, naturally meandering, stream-bank erosion. Clay soils in north and pumice soils in the south of the region	Steep catchments. Weathered rocks and clay	Franklin area: old, deep soil horizons, more likely to erode than other volcanic rocks
Awhitu and Kaipara peninsulas	Franklin, Clevedon Valley, East Tamaki, Henderson, Kumeu-Kaipara Valley, Kaukapakapa, Rangitopuni, Hotoe	Waitemata rocks in north and north-east, Whitford Hills and North Shore. Waitakere Ranges Hunua Ranges	Waitangi and Ngakoroa streams Auckland Isthmus Includes Mangere and East Tamaki in solid rock often on edge of basalt. Motions Creek, Meola Creek, Oakley Creek
Stream quality types	All or mainly native bush upstream or in groundwater recharge area	All or mainly native bush upstream or in groundwater recharge area	All or mainly native bush upstream or in groundwater recharge area
High	All or mainly native bush upstream or in groundwater recharge area	All or mainly native bush upstream or in groundwater recharge area	All or mainly native bush upstream or in groundwater recharge area
Medium	All or mainly pastoral and/or cropland upstream or in groundwater recharge area, with or without occasional native or exotic trees	All or mainly pastoral and/or cropland upstream or in groundwater recharge area, with or without occasional native or exotic trees	All or mainly pastoral and/or cropland upstream or in groundwater recharge area, with or without occasional native or exotic trees
Medium low	As above, but with discharges of rural wastes such as dairy sheds	As above, but with discharges of rural wastes such as dairy sheds	As above, but with discharges of rural wastes such as dairy sheds
Low	All or mainly residential and commercial development upstream or in groundwater recharge area	All or mainly residential and commercial development upstream or in groundwater recharge area	All or mainly residential and commercial development upstream or in groundwater recharge area
Very low	Mainly industrial or significant industrial areas upstream or in groundwater recharge area	Mainly industrial or significant industrial areas upstream or in groundwater recharge area	Mainly industrial or significant industrial areas upstream or in groundwater recharge area
Worked example – from Planning Sheet 1 and Field Sheet 2	Mainly industrial or significant industrial areas upstream or in groundwater recharge area	Mainly industrial or significant industrial areas upstream or in groundwater recharge area	Mainly industrial or significant industrial areas upstream or in groundwater recharge area
Lower Ngakoroa Stream: (D3) D3 = Volcanic soils, fourth order stream > 4.0m	A stream fed by groundwater and springs in its headwaters, but with pastoral and/or cropland uses upstream, including discharges of rural wastes such as dairy sheds. Stream Quality = medium low.	A stream fed by groundwater and springs in its headwaters, but with pastoral and/or cropland uses upstream, including discharges of rural wastes such as dairy sheds. Stream Quality = medium low.	A stream fed by groundwater and springs in its headwaters, but with pastoral and/or cropland uses upstream, including discharges of rural wastes such as dairy sheds. Stream Quality = medium low.
Upper Oratia Stream: C1 = Upland clay first order < 1.0m wide.	A stream fed by overland flow and groundwater, with almost all native bush upstream. Stream Quality = High.	A stream fed by overland flow and groundwater, with almost all native bush upstream. Stream Quality = High.	A stream fed by overland flow and groundwater, with almost all native bush upstream. Stream Quality = High.

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Field Sheet 2: Catchments of the Auckland Region

Figure 2 Stream Catchments in Northern Auckland Region



Stream Catchments in Southern Auckland

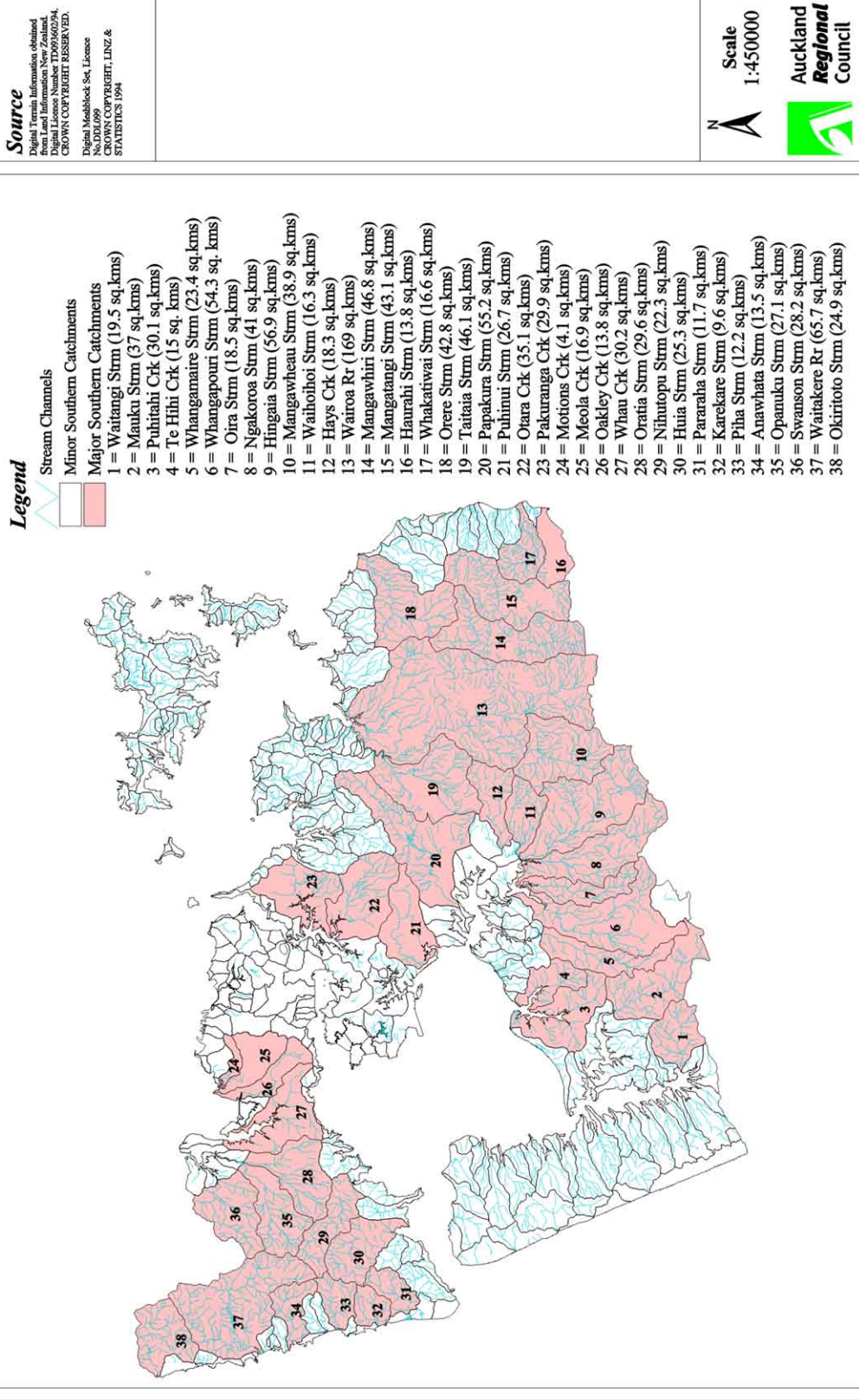


Figure 3 Stream Catchments in Southern Auckland Region

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Notes for Figures 2 and 3.

Any confined river in a catchment greater than 100km² (Hotoe and Wairoa) in the lowland/rolling sector can be expected to rise by up to 5-6m during a mean annual flood.

Unconfined lowland, flat catchments greater than 100km² are predicted to rise by 4-5m during a mean annual flood.

Confined (steeply incised) streams that is the top 10% of streams or the upper 10% of catchments are predicted to rise by 2-3 m during a mean annual flood.

Unconfined upland streams(not common) are predicted to rise by 1.5-2.5m during a mean annual flood.

All catchments less than 100km², upland or lowland, confined or unconfined will exhibit a smaller response than 1 and 2 above, but greater than 3 and 4.

In general the rise in a stream is around 2-4m, the rise is defined as the increase in water level above average stream levels for all seasons.

There are 61 major catchments in the Auckland Region they are identified and listed on Figures 2 and 3. All the remaining catchments (unnumbered) are minor, they lie close to the coastline and average around 3 km².

Field Sheet 3: Assessing existing riparian vegetation

Category	Description	Width and Percent of Cover	Length in Metres	Management Options
1. Native bush	Mature and semi-mature intact native bush with 3 tiers of vegetation; large trees, small trees and tree ferns, and understorey vegetation. Minimal evidence of disturbance in over 100 years. Common in protected areas and parks			Retain Protect from damage
2. Native shrub land	Young native shrub land with 2 tiers of native vegetation; small trees and understorey. Regenerated bush with small trees (less than 50 years old)			Retain Protect from damage
3. Native tree land	Mature native trees with grass understorey. Stock access has eliminated native understorey and small trees. Common in agricultural areas			Enhance Replanting
4. Exotic tree land	Thin row of exotic trees (e.g., willows) along streams within paddocks where stock has access to stream			Enhance Replanting
5. Exotic/native mix	Mixture of exotic and native trees and shrubs. Highly variable in the composition of vegetation. Harvesting of vegetation was not followed by revegetation			Retain Protect from damage
6. Exotic weeds	Vegetation dominated by exotic weeds			Revegetate
7. Pasture	Exotic grasses used by stock. Often associated with gorse, rushes, and scattered shrubs and trees			Revegetate Replanting
8. Cropland	Row crops, horticulture, glass houses, orchards and so on, with no or few trees and little or no riparian vegetation			Revegetate
9. Display gardens	Exotic plantings intended for display and variety. Often associated with grassed areas and a mixture of native and exotic trees			Enhance Replanting
10. No riparian vegetation	Urban land uses at or near the water s edge			Revegetate

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Field Sheet 4: New Zealand Land Resource Inventory Slope Classification

Source: The slope classification is described in the Land Use capability Survey handbook (Soil Conservation and Rivers Control Council 1971).

Slope groups	Slope angle (°)	Relief
A	0-3	Flat to gently undulating
B	4-7	Undulating
C	8-15	Rolling
D	16-20	Strongly rolling
E	21-25	Moderately steep
F	26-35	Steep
G	>35	Very steep

Additional symbols: / Average or compound slope between two slope groups, e.g. A/B
 + Complex slopes, first slope group is dominant, e.g. A+B
 ' Dissected slopes, e.g. 'A'

Field Sheet 5: Perennial Stream Size and Category

Perennial Streams			Catchment Geology and Soil Types			
Size (order – see Figure 4 Strategy.)	Width	Channel Shape and Cross Section (Sketch profile here)	A Dune	B Lowland Clay	C Upland Clay	D Volcanic Soils
First & Second	<1.0 m		A1	B1	C1	D1
Third	1 – 4 m		A2	B2	C2	D2
Fourth	>4.0 m		A3	B3	C3	D3

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Field Sheet 6: Assessment of stream, riparian and terrestrial problems

Resource Management Problem	Existing Problems Score			Explanation of Resource Management Problems	Management Options
	L	M	H		
In-stream					
Poor channel stability				In rural areas pugging by animals affects stream morphology and limits fish migration	Fence stream and supply drinking troughs
High contaminant inputs				Overland runoff and point sources eg wastewater, EMOFs and stormwater discharges.	Fence streams, plant & maintain buffer zones
Nutrient Enrichment				Overland runoff and point sources as above.	Fence streams, plant & maintain buffer zones
Lack of shade				High light levels, warm water and high nutrient concentrations lead to excessive aquatic vegetation.	Plant appropriate vegetation, see Planting Guide.
High summer water temperatures				Limits reproduction and or survival of invertebrates and fish.	Plant appropriate vegetation, see Planting Guide.
Inadequate or inappropriate carbon inputs.				Low nutrition levels and limited woody debris limits food supply and available habitat.	Plant appropriate vegetation, see Planting Guide.
Severe flood flows				Willows and aquatic plants can hold back stream flow and increase the risk of flooding. In small streams this can be a benefit at times of low flow.	Replace willows with alternative species, reduce light, water temperature and nutrients
Riparian margin	L	M	H		
Poor bank-side stability				Lack of bankside vegetation due to grazing or shading by overhead vegetation decreases bank stability.	Fence and check Planting Guide for vegetation set backs
Extent and health of existing native vegetation.				Assessed in Field Sheet 3 for protection, enhancement or restoration of riparian vegetation.	Check Planting Guide for appropriate species
Extent and health of existing exotic vegetation				Assessed in Field Sheet 3 for protection, enhancement or restoration of riparian vegetation.	Check Planting Guide for appropriate species
Terrestrial	L	M	H		
Extent of ecological corridors				Providing links between habitat areas.	Check Planting Guide
Recreation and landscape issues				Record any walkways, cycle tracks, swimming holes, other.	Protect and improve as appropriate
Cultural issues				Water, sites, waahi tapu, taonga.	Consult with iwi
Amenity and aesthetic issues				Looking at how the proposed riparian programme affects the wider catchment.	Consult with affected parties

Field Sheet 7: Management options for identified resource management issues

Management Option	In-stream and riparian problems						
	Temperature	Light	Habitat	Stability	Carbon ³	Nutrients ⁴	
Fence ¹			✓	✓			
Plant trees	✓	✓		✓	✓		
Plant shrubs				✓	✓		
Grass buffer zone ²						✓	
Willow Removal ⁵	✓	✓	✓	✓	✓		

Notes:

1. Fencing will protect the riparian zone from grazing and provide benefits for all categories of in-stream and riparian problems.
2. Grass buffer zones should be used on the terrestrial side of the planted riparian zone
3. Carbon refers to the amount of food input to the stream from sources such as native trees along the riparian zone
4. Nutrient inputs could include:
 - treated farm waste discharges
 - fertiliser and animal waste in runoff
 - stormwater runoff from urban areas
5. Willow removal will result in changes to all categories of in-stream and riparian problems. The removal of willows will be phased with replacement by a suitable alternative as part of a restoration programme.