

**A Strategy for achieving Riparian Management in the Wellington
Region**

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1. Introduction

1.1 Purpose of this Strategy

The purpose of this Strategy is to get more rivers and streams in the Region managed in a way that helps realise these environmental outcomes.

1. Improved water quality
2. Improved aquatic habitat
3. Healthier river ecosystems
4. The building of ecological links through the wider landscape
5. Halting the decline of regional biodiversity
6. Improved ability for Maori to exercise their traditional use of and guardianship over water and its environs
7. Improved community recognition of the part streams play in environmental systems, and consequent improved care for those streams by the community.

The Strategy aims to motivate people who own land beside waterways to manage their riparian areas in a way that improves the whole stream environment. The motivation will generally be financial (by subsidies or grants, or explaining private gains), or inspirational (by providing information). The riparian management programme described here is one of about a dozen Council projects to improve water quality and protect ecosystems around the Region (see Appendix 1).

The riparian management programme takes a whole stream approach that recognises the role of the stream in the wider environment, and the way various riparian management options can change and improve both the streamside environment and the instream environment. A whole stream approach means recognising that people's relationship with the environment is more than utilitarian. The programme recognises that people use and value riparian margins, that approaches for urban streams can be different to approaches for rural streams, and that the job is more than a lifetime commitment.

1.2 Connection with Biodiversity Programmes

Riparian areas are extremely rich in terms of their biodiversity. The main reason is that this environment is one where aquatic and terrestrial ecosystems meet and overlap. Some 450 species of native insect, 200 native crustaceans, molluscs and worms, 35 indigenous freshwater fish species, four frog species, and many of our 88 remaining indigenous land bird species live in the healthy examples of these areas, or visit them regularly. The problem is, the healthy areas which remain are much smaller than they once were and are still threatened by human activity. It also follows that riparian vegetation has decreased with the development of towns and cities and with the replacement of complex ecological systems with vast pastoral mono-cultures.

The Council has recently increased its investment in halting the decline in regional biodiversity by a considerable amount because it has recognised the

need to halt the continued loss of remnant areas, species, and ecosystem complexity and go some way towards restoring the Region's ecological balance. The riparian management programme outlined in this Strategy has been designed to complement these various pest management and ecosystem restoration initiatives for bush, wetland, estuarine, and coastal areas.

This Strategy has two principal foci - water quality and biodiversity – and several subsidiary ones. This presents both opportunities and challenges: opportunities, because it means we can seek to enhance the whole stream environment for a range of purposes and not just reduce contaminants in the water; challenges, because, as the Strategy shows, more complex management objectives are more costly.

2. What is riparian management?

Riparian management is the management of stream margins, generally by retirement and planting, to achieve specific outcomes for the stream, or the riparian zone itself. The riparian zone has been defined as “any land that adjoins or directly influences, or is influenced by, a body of water”.¹

2.1 What riparian management does

The careful management of riparian areas can bring about long term improvements to river environments by improving water quality and aquatic habitat, and increasing ecological links through the wider landscape. Depending on the kind of plants used and where they're planted, it contributes to healthier river ecosystems and helps rebuild regional biodiversity.

Nutrients, sediment and germs are the most common contaminants affecting water quality in rivers. Nutrients (nitrogen and phosphorus) speed up the growth of aquatic weeds, sediment affects the colour and clarity of the water and can smother the beds of stony bottomed streams, and germs make the water unsafe for people to swim in and can affect its suitability for stock water supply.

Many riparian management techniques will lower the levels of these contaminants reaching rivers. In rural areas, keeping stock away from streams, or limiting their access, stops them polluting water and damaging stream banks and beds. Ungrazed grass in riparian areas can be an effective filter of sediments and other pollutants if overland runoff is affecting water quality. The uptake of nitrate and phosphorus by streamside plants stops those nutrients reaching the river, and riparian wetland areas can remove nitrogen through denitrification.

Riparian trees can bring about significant improvements to water quality and stream habitat if they shade the stream effectively.² Shaded streams have

¹ Ministry for the Environment (2000). *Managing Waterways on Farms: a guide to sustainable water and riparian management in rural New Zealand*. Wellington, NZ. Ministry for the Environment. P 5.

² Rutherford, J C, R J Davies-Colley, J M Quinn, M J Stroud and A B Cooper (1999). *Stream Shade, towards a restoration strategy*. NIWA and Department of Conservation.

cooler water making it easier for fish and small aquatic insects to survive. Shaded streams also have lower sunlight levels on the water, which slows down the growth of aquatic weeds and algae such as periphyton. Prolific periphyton growths smother the beds of stony bottomed streams where aquatic insects and sometimes native fish would otherwise live.

Trees can also shade out and kill ground cover that helps protect stream banks from erosion. Loss of ground cover eventually causes the stream channel to change from the narrow deep channel typical in pasture land to the wider and shallower channel more typical in forested land.³ This may or may not be a desired effect from the landowner's point of view, and may be avoided by planting species that provide partial shade.

An appropriate variety of riparian vegetation can stabilise stream banks. This means less streamside land is lost to the landowner, and less soil is washed into streams. Muddy water not only makes life difficult for fish and aquatic insects; soil usually has phosphorus bound up with it, some of which gets released into the water.

Rivers are natural corridors through the landscapes and when bordered with native plants they help join up otherwise fragmented ecosystem patches. Native plants also help provide a food supply of insects to native fish⁴ and birds. The current rate of decline in regional biodiversity could be slowed or even reversed if native vegetation is encouraged to grow in these corridors and in selected strategic areas. Native vegetation may be planted amongst willows or other exotics growing alongside or near rivers, or may be specifically planted to bolster an existing area of significant indigenous vegetation, or to provide habitat and food for insects and birds. However it grows, native vegetation builds complexity and diversity into the Region's ecological systems.

The health of riparian areas is of considerable significance to Maori. To Maori, all parts of the natural world possess a mauri or life force (including humans) and all life is related. It follows that the health and wellbeing of the environment will affect the welfare of the people. Each river or stream carries its own mauri, a water body with a healthy mauri will provide for healthy ecosystems. Contaminants running into water ways contribute to the degradation of the mauri. Where the riparian vegetation has been removed or altered, it is also likely that mahinga kai species have been impacted upon. Consequently, Maori take a strong interest in efforts to restore the proper functioning of water bodies and associated ecosystems.

Streamside areas are highly visible parts of the environment that people enjoy looking at and for recreation. This is the stream's amenity value. People seek out waterways with high amenity for picnicking, swimming, bird watching,

³ Davies-Colley, R J (1997). Stream Channels are Narrower in Pasture than in Forest. *New Zealand Journal of Marine and Freshwater Research* **31**:599-60.

⁴ McDowell, R. (2001). Native fish conservation awareness workshop. A workshop sponsored by Department of Conservation at Kapiti Community Hall, Paraparaumu, 4 May, 2001.

fishing, food gathering and so on. On private land, landowners enjoy the increased amenity and sometimes increased property values as well.

When communities are involved in the rehabilitation of riparian areas in their neighbourhoods, they gain increased awareness of the part streams play in their environment. Building this awareness can increase their willingness and desire to get involved in solutions to caring for the streams.

The overall result is that managed and planted riparian areas have a “disproportionately large role” in decreasing land use effects on streams and aquatic life,⁵ and make significant contributions to building ecological links through the landscape. Benefits to water quality in rural areas can often be achieved by simply retiring the stream from stock access, but most benefits to aquatic habitat, biodiversity and public enjoyment will generally require going further with conservation planting.

2.2 Riparian management options

Some riparian management options already practised in New Zealand are

- **electric fencing** to prevent or restrict stock access to stream banks and streams
- **grass strips** where the grass alongside small creeks and streams is left to grow so that it filters overland flow of contaminants
- **bank protection trees** where unfenced poplars and willows primarily prevent bank erosion but also inhibit stock access
- **production planting** where trees are grown for harvesting (timber, nuts, oils) with or without fencing
- **permanent 8 wire fencing** to exclude all stock from stream banks and streams
- **wetland planting** where headwater and small tributary riparian wetland areas are protected or restored
- **conservation planting** of trees, shrubs, and grasses, ideally with native vegetation, and in rural areas permanent fencing and separate water supply.

Choosing the management option that’s right for the site depends on the impacts of the surrounding land uses on the stream, the existing water quality and aquatic habitat of the stream, and what beneficial changes can be achieved to the stream environment for what cost. This “horses for courses” approach can be staged into “first steps” and “best practice” management option for riparian areas.⁶ These management options provide initial and then long term benefits to the whole stream environment.

For example, where unfenced streams flow through dairy farm land in an upper floodplain area, an appropriate First Step option may be to install electric fencing to prevent cow access, and establish an alternative water

⁵ Collier et al., (1995). *Managing Riparian Zones: a contribution to protecting New Zealand’s rivers and streams*. Vol. 1: Concepts and Vol. 2: Guidelines. Wellington, NZ, Department of Conservation.

⁶ Quinn, J., et al., (2000). Riparian Zone Classification Improves Management of Stream Water Quality and Aquatic Ecosystems. NIWA.

supply if none exists. This may be followed up with planting trees for bank protection and shade.

Best Practice is a comprehensive level of management that is tailored to the site to achieve specific outcomes for the stream or riparian area. Best Practice options usually involve permanent fencing with conservation planting where a variety of plants are selected to achieve specific outcomes such as pollution interception and filtration, vegetation overhang for fish refuge, and native vegetation selected to enhance biodiversity. Appropriate Best Practice options will depend on the dominant impacts on the stream from surrounding land uses, the dominant functions and uses of the riparian area, and the potential aquatic and vegetation habitat in and alongside the stream.

It is important to recognise that Best Practice is not needed in every situation and that riparian management need not be prohibitively expensive, particularly if the outcome being sought is a reduction in sediment, phosphorous, and faecal contamination – a common problem in our Region. Casual fencing, carefully placed grassy filter strips, and small wetland seeps can prevent these contaminants entering streams, while good livestock practices, and soil and pasture management can reduce surface runoff to begin with.

3. Why the Council needs to act

There are two reasons for the Council to be actively involved in riparian management. One is to show leadership by working with individuals and the community to avoid, remedy and mitigate the adverse effects of activities on the environment. The other is to fulfil the statutory commitment the Council has made when choosing effective non-regulatory methods over regional rules as its preferred policy approach to land use impacts on water.

3.1 Controlling adverse effects of activities on the environment

Urban development and some activities associated with urban areas, and some farming and forestry practices can all cause adverse effects on rivers and streams. Discharges of sewage or agricultural effluent to rivers (point source discharges) cause immediate adverse effects downstream. Activities like pastoral farming, stock access to streams, forestry, horticulture, vegetation clearance, and stormwater runoff, generally have adverse effects that occur more gradually, but can affect much larger areas.

Environmental improvements arising from better treatment of contaminants discharged directly to our waterways are expected to show up in some rivers over the next five years. But our investigations tell us that point source discharges are only part of the story. The levels of nutrients and other contaminants that trickle overland into our rivers, called non-point source discharges, are not decreasing. For example, our water quality data indicate that in the Ruamahanga River, downstream of all the main tributaries, nearly 90 percent of the nutrient load is from overland runoff and bank erosion during elevated flows. Faecal contamination during elevated flows is four times

higher than it is during low flows. This increase is thought to be caused by runoff from surrounding land.⁷

Riparian management will help reduce the adverse effects of land uses by intercepting contaminants before they reach the rivers, and reducing effects of contaminants in the rivers by shading the streams. This management needs to be directed at a whole stream approach integrated with land management and soil conservation.

3.2 Fulfilling statutory commitments

In its main policy documents (the Regional Policy Statement, the Regional Freshwater Plan, and the Regional Soil Plan), the Council has decided to take a non-regulatory approach to protecting riparian vegetation, and to controlling many of the effects of land use on water quality. The Council has stated that its preferred approach is to promote appropriate management of riparian areas (RPS Freshwater Policy 8).

There are essentially four ways the Council decided to do this (see Appendix 1). These are by —

- promoting means available to territorial authorities
- appropriately managing Regional Council owned or managed land
- identifying and then targeting degraded streams that would benefit from riparian management, and
- providing information and encouragement to landowners to retire and plant riparian margins.

The Council continues to work with territorial authorities to promote means available to them. It is investing additional funds so that Council land is managed appropriately, and is identifying streams, and types of streams that would benefit from riparian management. The next step in the programme is to target those streams and make progress in providing information and encouragement to landowners to retire and plant riparian margins.

Riparian management also contributes to implementing policies in the Ecosystems chapter of the Regional Policy Statement. These policies include integrating ecological principles into resource management practice, providing linking corridors and buffer zones, and encouraging the planting of native vegetation (RPS Ecosystems Policies 3, 9 and 10).

4. Recognising and providing for matters important to Maori

Maori have strong cultural, traditional and historic links with wetlands and inland waterways. These resources provide habitat and spawning grounds for indigenous plants, bird and fish life, building and weaving materials such as raupo and flax, and medicines and dyes used for seasoning timber and restoring precious artefacts. They are also a traditional source of foods such as eels, whitebait and watercress. Protecting the integrity of valued freshwater

⁷ Wellington Regional Council (2001). *Identification of non-point source pollution to waterways in the Wellington Region* (in press).

resources remains an important aspect of the responsibilities of Maori who are identified as the kaitiaki (guardians).⁸

Values that are assigned to specific water bodies include

- the roles of waterways in tribal creation stories
- the proximity of important waahi tapu, waahi taonga, settlement or other historical sites in specific waterways or found in the riparian areas adjacent to the waterways
- the use of waterways as access routes or transport courses
- the value of waterways and riparian areas as sources of mahinga kai and other cultural materials
- the continued capacity for future generations to access, use and protect the resources of waterways and riparian areas.

Iwi of the Wellington Region will be part of the decision-making process in determining where and how we should direct our efforts for promoting riparian management. Iwi need to be involved to identify those places that need attention in order to maintain or support mauri. Since each river's mauri is different, it is likely the way of restoring the river ecosystem should also vary. Only the tangata whenua, as tiaki, know how the waterways have been valued and used by Maori. Iwi involvement in projects will be encouraged wherever possible.

Iwi will also be consulted about the sorts of plants they prefer planted in riparian areas. For example, in areas of the Kapiti Coast that historically had huge flax resources, there may be a preference to plant appropriate flax plants again to provide a local resource for Iwi or to encourage tui and other birds to visit the area.

5. How to encourage riparian management

The two most effective ways of bringing about better management of the riparian zones of rivers over the long term are to encourage landowners through financial incentives, and to demonstrate the benefits of riparian management options through information and education. These are described here.

Many landowners are becoming aware of how their use of the land impacts on water ways, and they are changing their practices accordingly. Others are slow to change. In a national study, the Ministry for the Environment identified that the main reasons why are cost, and lack of knowledge about the true impacts of farming (including pastoral farming, forestry, cropping, fruit growing, and so on) and farm generated contaminants. The report concluded that “where the

⁸ Information here has not yet been reviewed by the Iwi of the Wellington Region, and may change. The information in this section has been sourced from the existing relationship between tangata whenua and the Regional Council and from a publication produced by the Ministry for the Environment (2000). *Managing Waterways on Farms: a guide to sustainable water and riparian management in rural New Zealand*. Wellington, NZ. Ministry for the Environment.

knowledge does exist, quite extraordinary progress has been made by individual landowners, often at little or no net cost to the farming operation”.⁹

5.1 Providing financial encouragement

Providing financial encouragement for environmental outcomes is a tool with a proven track record. It is being used successfully by the Council in reducing erosion through soil conservation grants, and restoring wetlands and planting public land beside streams with Care Group funding. The Council can build on these two approaches to encourage people to take part in riparian management.

Both approaches require financial contributions from the Council towards the costs of the particular riparian management option chosen. Both approaches build on the Council’s approach to require landowners and communities to become involved in solving the problem of degraded water quality and aquatic habitat in the rivers and streams flowing through their properties. The Council’s role is to provide the tools to enable this to happen. Setting an appropriate level for the Council’s financial contribution is discussed in section 6.4 below.

5.1.1 Private land

On private land, the Council can identify streams that should benefit from riparian management and take a planned approach for a group of properties that affect the stream. This would allow for an integrated “whole stream” approach across several properties, and allow the Council to be proactive in taking the idea directly to landowners where we see riparian management will be effective.

However, a willing land owner should not be discouraged from undertaking riparian management or better stock or pasture management because he or she does not have a farm plan or is not part of a joint planned approach. Many farms are in the right place or are big enough to make a difference on their own to water temperatures and stream health when riparian management is undertaken. What is needed is for the proposed works or change in management to be clearly thought through, with agreed targets and, where relevant, concept drawings or plans to show what is intended. A visual depiction of the end result is a good way to involve all members of the landowner’s family and keep focused on a programme of works or actions that are likely to take many years to out in place.

5.1.2 Public land

The Council is already successfully using the community care group approach to enhance areas of public land, including streamside areas. Of the 18 projects funded in this way in 2000/01, 15 are restoring riparian areas (including wetlands) to achieve stream or river improvements. To achieve effective riparian management, the care group approach should be retained as the method of choice for areas where streams to be restored flow through public land.

⁹ Ministry for the Environment (2000). *Managing Waterways on Farms: a guide to sustainable water and riparian management in rural New Zealand*. Wellington, NZ. Ministry for the Environment. P 3.

This approach can respond to community initiatives to protect or rehabilitate streams, and can even be used in mixed situations where a stream flows in part through private land. It also recognises that riparian planting will provide some benefit to almost any stream and builds on people's existing enthusiasm and willingness to improve their environment.

5.2 Demonstrating benefits

Getting high levels of landowner participation in riparian management relies on increasing their understanding of its benefits, and hopefully causing a domino effect throughout entire catchments. The experience of other Councils (e.g. Hawke's Bay and Manawatu-Wanganui) is that riparian retirement and planting is embraced by landowners once they see it working in their locality.

The Council's experience with supporting covenants for protecting private land is that many landowners are enthusiastic about protecting and enhancing the natural environment, and will do so when motivated by relevant information and offered some financial assistance. Some 100 hectares of land in the Wellington Region was protected by QE II National Trust covenants between July and December 2000, with funding assistance of less than \$20,000 from the Council.¹⁰

Demonstrating the benefits of riparian management will also encourage people to retain existing riparian margins. This avoids the regulatory approach to protecting riparian vegetation that was considered but rejected during consultation on the Regional Soil Plan, and can complement the work Council is doing promoting the use of QE II covenants.

A variety of educational, promotional, and communications tools will be needed to reach landowners across a number of catchments. The rate of uptake of these tools has not yet been determined, but the Council is gaining experience in how to communicate effectively through its biodiversity, environmental education, and catchment focused initiatives (Waiwhetu, Pauatahanui Inlet). These lessons will be applied to riparian management.

In part, the Council needs to inform landowners about how their activities impact on waterways and wetlands so that people can understand **why** they need to change. In part, advice is needed about **how** to implement the various management options (from first steps to best practice) so that keen farmers or care groups can proceed relatively unaided. We need to demonstrate through these communications that riparian management need not be a drain on farm productivity, and that costs can be shared with the regional community.

In large part, however, the Council will need to help landowners with the wider issues of livestock management (not overstocking, avoiding treading and pugging, keeping cattle out of streams and drains), soil management and pasture development (not cultivating right up to the stream edge, avoiding overgrazing, reducing erosion, fertiliser application, and using filter strips). In

¹⁰ Porteous, T. (2000). *Implementation of the Ecosystems and Biodiversity Programme*. Wellington Regional Council Environment Committee Report 01.36.

other words, that good management of waterways does not begin and end at the water's edge but stretches across the whole of the farm.

6. Determining Council financial contributions

To determine who should pay for riparian enhancement or how the costs should be apportioned, we need to allocate the costs between those whose activities increase the need for riparian management (the exacerbators) and those who benefit (the beneficiaries). To make this choice, we have identified the likely costs, benefits, and beneficiaries.¹¹

6.1 Who benefits from riparian management?

Generally speaking, there are six classes or kinds of benefit from riparian management. These are —

Biodiversity value – the benefit to all living organisms of the continued healthy functioning of the riparian and riverine ecosystem. Aquatic fauna require good water clarity, low weeds, low water temperatures, and diversity of habitat. Birds require roosting and nesting places, and links or “stepping stones” to other habitat. All fauna (birds, fish, insects and so on) require their appropriate food supply. Flora require diversity of habitat, and plant and animal pest control.

Recreational benefits – such as the ability to use the water for contact recreation (paddling and swimming), fishing, and bird watching, and aesthetic surroundings. Water contact requires good water clarity, low weeds, low faecal contamination, and access. Fish and birds require working ecosystems. Aesthetic surroundings depend on context and perception.

Ecosystem services – benefits provided for people such as pollutant removal, flood protection and bank protection. Pollutant removal requires filtering vegetation or denitrification zones. Flood protection requires healthy upper catchments and effective wetlands. Bank protection requires vegetation that tolerates variations in water levels and withstands flood flows.

Landowner benefits – benefits provided to landowners, and others, such as shade and shelter for stock, clean stock water (for drinking and dairy shed cleaning), a clean green image, meeting environmental quality assurance programmes, and aesthetic surroundings. Shade and shelter require appropriate trees planted in accessible places. Clean stock water needs to be palatable with low faecal contamination.

Bequest benefit – the benefits for future generations from their potential use and enjoyment of the resource.

Cultural benefit – the benefit arising for Maori from their use of the resource in ways which they consider appropriate.

¹¹ The cost-benefit analysis here relies heavily on research funded by Environment Waikato, the New Zealand Rural Trust and the Matamata-Piako District Council for the Piako River. See Environment Waikato (2000). *Case Study - Riparian Management on the Piako River: A New Approach to Costs and Benefits*.

Of these six benefits, the landowner is a beneficiary, or joint beneficiary of biodiversity value, ecosystem services, recreational benefits, and landowner benefits. The wider community is a beneficiary of all six benefits, to various degrees.

Not all riparian management options (from simple stock exclusion to full-scale ecological restoration) will necessarily realise all six benefits. We assessed the relative benefits of implementing the range of riparian management options at the streams in the pilot programme,¹² and compared these to the streams' current condition (see Table 3 in Appendix 3). The assessment showed that the greatest community benefit, particularly to biodiversity and recreational values, is achieved by Best Practice options (i.e. doing more than simply excluding stock). This suggests that a greater level of community contribution could be made to riparian works that incorporate more comprehensive, and thus more expensive, management options.

6.2 What are the costs of riparian management?

There are three kinds of costs associated with riparian management.

Material costs – such as for plants, herbicides, fencing materials, electricity for fences, stock crossings, and troughs and pumps for alternative water supplies.

Labour costs – such as for planting plants, weed control, constructing fences, and shifting electric fences.

Lost opportunity costs – such as lost production on rural land. Lost opportunity costs are generally not incurred when riparian margins are managed on public land unless there is a loss of public access.

The level of cost depends on the kind of works undertaken, and the kind of surrounding land use. Without financial assistance, or labour volunteered by community groups, all of these costs fall on landowners.

6.3 Four options costed

The estimated costs of applying four kinds of management to 100 kilometres of stream are set out in Table 1 below. Management options range from simple pole planting (e.g. poplars) without stock exclusion, to full stream retirement with native species replanted.

Lost opportunity costs are extremely variable, not only from place to place, but from year to year, and so were not calculated for this exercise. For example, lost production value doesn't apply to land in urban areas, and in rural areas the lost value depends on the actual amount of production lost, and the value of that production.

¹² For a description of the streams in the pilot programme see Appendix 2.

Table 1 Estimation of relative costs of applying various riparian management options to 100 kilometres of stream

	Stream planted and grazed (\$ '000s)	Temporary stream retirement, some grazing (\$ '000s)	Stream retired (2.5m), planted with exotic seedlings (\$ '000s)	Stream retired (5 m), planted with native plants (\$ '000s)
Material costs				
Electric fence		300		
Permanent fence			960	960
Stock water trough		464	464	464
Stock crossing		300	300	300
Protected poplar or willow poles	315	315		
Seedling planting (exotics)			80	(160)
Native Plants			(312)	625
Labour costs				
Electric fence		390		
Permanent fence			1,415	1,415
Planting	95	95	40	125
Weed control			70	140
Water supply		48	48	48
Lost opportunity costs	—	—	—	—
Total estimated cost	410	1,912	3,377	4,077

These costs are estimations of all material and labour costs associated with the kind of management, regardless of who does the work. The estimations assume that the stream margin has no existing fences or desired vegetation, and that stream retirement will necessitate the installation of stock water supplies in eight paddocks per kilometre for dairy farms, and two per kilometre for non-dairy farms. In reality, costs will tend to be lower than these estimates because some streams are already fenced off and many dairy farmers already have separate stock water supplies.

The estimations show that the greatest cost associated with stream retirement is for permanent fencing (70% of the overall cost for a planted riparian width of 2.5 m). For wider fenced riparian areas, the actual fencing costs stay the same, but plant and weed control costs increase. For a fenced and planted riparian area with an average width of 5 metres on both sides of a stream (one hectare per kilometre), the material costs of exotic plants make up only about 4% of the overall cost, cf. 15% if native plants are planted.

Urban streams are generally on public land. Riparian management of these streams has significantly higher weed control costs than rural streams, but no stock associated costs, such as fencing and stock water supplies. So, although

the overall costs for urban streams are less than half the costs of rural streams, more than 80% of those costs are for the plants and weed control. Volunteer labour associated with clearing, planting, and maintaining an area of public land generally covers the rest of the total project cost.

A summary of the overall costs for these four riparian options applied to streams under different land uses is shown in Table 2 below. These cost estimates include labour, which may actually be volunteered or contributed by landowners. Further, these costs relate to active management of the riparian zone. Other farm management methods may also produce reduction in sediment, nutrients, or faecal contaminants entering streams without the need for active management and its consequential costs. In most cases, a combination of improved practices and active management will be likely.

Table 2 Overall costs of four riparian options applied to 100 kilometres of streams (rural and urban)

	Stream planted and grazed (\$)	Temporary stream retirement (\$)	Stream retired with exotic plants (\$)	Stream retired with native plants (\$)
Rural (dairy)	410,000	2,053,000	3,377,000 (2.5 m width) 3,563,000 (5 m width)	3,631,000 (2.5 m width) 4,077,000 (5 m width)
Rural (sheep)	410,000	—	2,993,000 (2.5 m width) 3,113,000 (5 m width)	3,247,000 (2.5 m width) 3,693,000 (5 m width)
Urban	—	—	—	1,150,000 (5 m width)

6.4 A fair balance

A comparison of the benefits (see Appendix 3) that might be expected when different forms of riparian management are applied to the three streams in the pilot programme shows that stream improvements brought about by First Steps riparian management options will bring some benefit to both landowners and the wider community. More expensive Best Practice options (retirement and planting) are needed to realise significant improvements in the predominantly community benefits of river recreation and biodiversity.

The costs analysis shows that for streams flowing through pastoral land, more than half the cost of the options involving stream retirement is for permanent fences. This cost applies regardless of the width of the retired area. Sufficient riparian width, however, is an important part of the Best Practice package. The way in which costs are apportioned needs to encourage landowners to retire enough streamside land to achieve improvements in water quality and aquatic habitat, and to retire more land if improvements in biodiversity and recreation are desirable and achievable.

Allocating some costs to landowners recognises that they have a duty under the Resource Management Act 1991 to avoid, remedy or mitigate the adverse effects of their activity on the environment. Allocating the remaining costs between the community and the landowner recognises that both are beneficiaries of the riparian management implemented, but that the level of community benefit increases more than the landowner's when wider strips are planted, especially with native plants.

A fair community contribution/landowner balance therefore recognises that landowners are both exacerbators and beneficiaries, and that the greatest community benefit occurs when Best Practice options are implemented. The level of community contribution to riparian management works on private land should reflect the increasing community benefit that accrues from more intensive treatment. It is proposed, therefore, that the following subsidy percentages apply.

- Works comprising temporary or partial exclusion of stock, with any directly associated works – 30%
- Works comprising permanent exclusion of stock, with any directly associated works and predominantly exotic vegetation planted – 40%
- Works comprising permanent exclusion of stock, with any directly associated works and predominantly native vegetation planted – 55%

Guidelines will be prepared to direct staff about riparian management options, including how to determine what part of the works will be considered as directly associated with the riparian management project. For example, works directly associated with stock exclusion would include stock water supplies and stream crossings.

Setting the Council contribution at these levels would give Council's support for riparian management some equivalence with other works to which the Council contributes. Comparable works with a community benefit include one-off river erosion control works (i.e. not in a scheme), which attract a Council contribution of up to 30%, floodplain and river management works which attract a Council (general rate) contribution of up to 50%, and soil conservation works which attract a Council contribution of up to 45%.

6.5 Possible future costs for the Council

With grants set at these rates, the Council might reasonably expect future riparian management options to cost the following (depending on the option chosen) —

- Up to \$615,900 for some stock exclusion of 100 km of rural streams (30% of \$2,053,000)
- Up to \$1,425,200 for 100 km of rural streams retired and planted in mainly exotic vegetation (40% of \$3,563,000)
- Up to \$2,242,350 for 100 km of rural streams retired and planted in native vegetation (55% of \$4,077,000).

How quickly the Council chooses to implement any or all of these options, or indeed whether to proceed with a full-blown riparian management programme at all, can be determined when the Council next considers its Long Term Financial Strategy. Achieving landowner buy-in and moving to the implementation of works is a time consuming exercise which could restrict the Council to little more than 10 km a year in the early stages (until demand takes off). This puts the above figures into perspective. At 10 km per year, the cost of even the most expensive option does not exceed \$250,000.

The same subsidy percentages cannot be applied to urban streams on public land because even a 55% Council contribution would not cover the capital costs of the plants and weed control. These streams will need to be funded on a different basis, either with additional contributions from the landowner, generally the city or district council, or by the Regional Council covering all costs except labour. This reflects the high community benefits that can be achieved in urban areas.

Urban streams have significant potential amenity and biodiversity benefits from streamside restoration, especially if combined with stormwater quality enhancement initiatives. Riparian management solutions for urban streams will need to be developed with the territorial authorities and combined with other approaches such as stormwater education programmes, encouraging less use of culverts and concrete channels, and increasing the amenity value of the streams.

At present, the care group approach is in its infancy, and we do not know whether the groups have the resources to do full scale riparian restoration. While more money may be needed to implement riparian enhancement in urban areas, the groups involved may not be able to use that money effectively. This issue will need to be resolved before this Strategy is finalised.

7. Where to begin: rivers that would benefit from riparian management

The criteria for identifying and prioritising water bodies for which riparian management may be appropriate are given in the Regional Policy Statement (see Appendix 1). Using these criteria as the basis to achieve the purpose of this Strategy, we should direct our efforts at streams where the dominant functions of managed riparian areas will be to provide

- bank stability, stock access control, shade, nutrient removal, pollutant filtering and woody debris inputs (to improve water quality, aquatic habitat, and unhealthy river systems)
- native plant and bird habitat (to halt the decline in biodiversity, including aquatic biodiversity, and build ecological links through the landscape),
- aesthetics and recreation (to enhance amenity and inspire community care of streams), and
- spiritual or cultural value to Maori.

According to the State of the Environment Report for the Wellington Region,¹³ there has been little or no improvement in the water quality in our rivers and streams over the last five years. Generally, the mid to lower reaches of the Region's rivers have the poorest water quality and aquatic habitat. While all rivers deteriorate to some extent as they flow through developed land, ten rivers in the Region are so degraded they are no longer suitable for aquatic ecosystems in the mid to lower reaches, and two large rivers are not usually suitable for contact recreation, again, in their mid to lower reaches (see Appendix 7 of the Regional Freshwater Plan). Some of the degraded rivers are affected by direct discharges, some by land uses, but most are affected by a combination of both.

Riparian management is of little use in rehabilitating rivers whose degradation is mostly caused by direct discharges. For these rivers, the solution lies in addressing adverse effects with requirements in resource consent conditions.

Providing stock access control, shade, nutrient removal, and pollutant filtering will work best on small streams with open channels that are also affected by overland runoff and sedimentation. This means targeting the small tributaries upstream of degraded rivers. Riparian management will help decrease those streams' contribution of contaminants, and stop the elevation of water temperatures that occurs when small streams flow through open country over large distances.

Providing plant and bird habitat will work best on streams near significant areas of indigenous vegetation and significant habitats of indigenous fauna. But even small areas of indigenous habitat can help build ecological links by providing a stepping stone between larger areas.

Providing or improving amenity and recreational opportunities will work best on areas with high visibility and accessibility to the public, or streams that will lead to the enhancement of water quality in those areas.

Recognising the high costs involved in full streamside management, and the large area of streamside land that would benefit from such management, stream management will need to be targeted. But on current information, it is difficult to know where to start. This Strategy proposes continuing with the three pilot streams over the next two years. These are the Kakariki Stream (a tributary of the Ngarara Stream) the Enaki Stream (a tributary of the Mangaterere Stream) and the Karori Stream. At the next level, we could concentrate on the degraded rivers identified in the Regional Policy Statement¹⁴ and the Regional Freshwater Plan¹⁵ or the streams identified in any Annual Freshwater Monitoring Report as suffering from non-point source pollution.¹⁶

¹³ Wellington Regional Council (2000). *Measuring Up: the state of the environment report for the Wellington Region*. Wellington Regional Council.

¹⁴ Waikanae River estuary, Mazengarb Drain, Ngauranga Stream, Makoura Stream.

¹⁵ Mazengarb Drain, Tikotu Creek, Ngarara Stream, Lower Mangaone Stream, Waiwhetu Stream, Wainuiomata River, Ngauranga Stream, Makoura Stream, Mangaterere River, Makara Stream.

¹⁶ Karori Stream, Waitohu Stream, Porirua Stream, Mangaroa Stream, Pauatahanui Stream.

There are a large number of waterways in this list, so a considerable amount of work will need to be done to determine their potential for improvement, and whereabouts on the streams we should focus. Five of these priority streams are influenced mainly by sewage and other large discharges. These are the Wainuiomata River, Mazengarb Drain, Ngarara Stream, Makoura Stream, and the Mangaterere River. Riparian work in their upper catchments would contribute to overall improvements in aquatic habitat and would complement the improvements in stream water quality expected as upgrades to sewage treatment take effect over the next five years.

We are also undertaking an analysis of other streams throughout the Region to determine which ones would benefit from riparian management, and Iwi will be consulted for advice about where and how riparian management could contribute to achieving their resource management objectives. This will enable a more refined set of priorities to be determined by the end of 2002.

The priority streams that are influenced by a combination of direct discharges and surrounding land uses are evenly spread between mainly urban (Tikotu Creek, Porirua Stream, Waiwhetu Stream, Ngauranga Stream, and Karori Stream) and mainly rural (Waikanae River, Lower Mangaone Stream, Makara Stream, Waitohu Stream, Mangaroa Stream, and the Pauatahanui Stream). The Waiwhetu Stream and the Pauatahanui Stream already have separate programmes dedicated to their rehabilitation, so our efforts would not need to be directed at them.

8. What we need to do to make riparian management happen

8.1 The next two years

The Council is supporting riparian work in three pilot programmes begun in 2001 (see Appendix 2). The two objectives of the pilot programmes are —

- to demonstrate the benefits of riparian management in a way that is meaningful to the people of the Wellington Region, and
- to enable Council officers to learn how to carry out riparian management effectively.

With the funds allocated over the next two years, the Council will be able to assist with the retirement and planting of about one kilometre of each of the three streams in the pilot programme (three kilometres altogether), and up to another three kilometres on some more streams, starting with the priority catchments listed in section 7. We expect that once landowners see the progress made on streams in this Region, there will be increased demand for information and assistance for other streams.

Over the next three years, the Council will —

1. Consult with Iwi about this Strategy and amend the Strategy accordingly.
2. Consult with farmers and other landowners about ways to promote riparian management on private land.
3. Consult with territorial authorities about ways to integrate streamside enhancement with associated issues like stormwater management.
4. Prepare staff Guidelines about the kinds of riparian management that could attract each of the 30%, 40%, and 55% grant rate.
5. Assess the success of the three pilot programmes in terms of achieving their purpose, and follow up any proposals or requests for riparian management projects nearby.
6. Hold field days at each of the three pilot sites where we will:
 - show any changes in aquatic habitat and water quality and explain the significance of those changes
 - disseminate regionally relevant information about the benefits of riparian management
 - have professional expertise available to explain riparian management issues such as weed control, appropriate riparian plants and planting plans, and how to get the maximum benefit to the stream.
7. Prepare and disseminate information and advice for landowners and other relevant parties, and explore private sector involvement, such as Dairy Company requirements, in future initiatives. To start with, these educational endeavours can be directed at the rivers and streams identified in section 7 of this Strategy.

8.2 Making a long term commitment

Appropriate management of riparian zones throughout the Region is a very long-term project where gains in water quality and stream habitat enhancement will only become evident over long time periods. Uptake of a riparian management ethic, especially unassisted uptake, is likely to be gradual.

Investing in riparian management is comparable to the Council's long-term investment in soil conservation. Most of the Council's soil conservation work is in the Wairarapa where there is about 95,000 hectares of unstable pasture land. Since 1953, the Council has helped prepare farm plans for 90% of the 530 farm properties in this area.¹⁷ This long term project is achieving our objectives to promote soil conservation and sustainable land use in the Wellington Region.

If it wishes to employ these techniques, the Council will, in future, need to make a similar commitment to riparian management. At this stage in the development of this Strategy, we foresee a need for the Council to commit to:

¹⁷ Memorandum from Dave Cameron to Ian Gunn, 1 May 2001.

1. an annual budget of at least \$250,000 over the ten years from 2003-04, to make a difference to high priority streams.
2. a review of the improvements in the streams where the Council has supported riparian management and an investigation of ways to develop the programme if necessary.

This level of financial contribution (\$250,000) could see about 25 km of urban streams and 90 km of rural streams planted in native vegetation after 10 years. Of course, where lower cost options are used for rural streams, more kilometres of streams will be able to be managed, or the total cost reduced. Similarly, the use of community, educational (school) and other low cost labour options can bring savings in urban areas and on public land.

8.3 Who will do the work?

The pilot programmes are being supported by Land Management staff in the Wairarapa Division and Resource Policy staff in the Environment Division. Potential future areas are spread between mainly urban streams on public land in Paraparaumu, Porirua, Hutt City and Wellington City, and rural streams mainly on private land in the Kapiti Coast, Porirua, Wellington, and the Wairarapa.

Staff in the Resource Policy and Environment Co-ordination Departments of the Environment Division are already building experience with Care Groups working on public land. This approach, especially if incorporated with joint projects with the territorial authorities, is the most appropriate to use to support and encourage riparian management for urban streams.

Staff in the Operations Department in the Wairarapa Division have considerable experience in working with farmers to promote sustainable land management. Riparian management is a logical extension to some of their work and can be managed within the soil conservation grant framework that is also well established. For the rural Wairarapa streams, the Operations Department is well suited to delivering riparian management within a framework similar to the soil conservation grant scheme.

For rural Kapiti Coast, Porirua and Wellington streams, a joint approach by both the Wairarapa and Environment divisions can be used, based on the experience gained with the pilot project for the Kakariki Stream. The Kakariki stream project uses a combined landowner/community approach to enhance a stream degraded by both urban and rural land uses.

8.4 Not compromising flood prevention measures

Amongst other roles, the Council is responsible for mitigating flooding effects on the community. To achieve this, the Council provides an advisory service on flooding and maintains flood defence systems in some catchments. In areas targeted for riparian management where there is an identifiable flood risk, the effects of any riparian planting on flooding must be considered, and flood protection measures must not be compromised.

For example, plantings on stopbanks must be prevented, and the extent, position and the orientation of plantings in relation to the river may need to be restricted to ensure the flooding effects are not increased and flood defence systems can be maintained. At the same time, the potential of planting for flood mitigation to contribute to greater ecological diversity in river corridors should not be overlooked.

9. Conclusion

Riparian management is not a silver bullet to reduce all effects of all land uses on streams. Stormwater reduction and treatment options, particularly in urban areas, can also help mitigate the effects of the use and development of natural resources on the environment, as will sustainable land management practices.

In rural areas, sustainable land management practices like planting trees to reduce erosion, and applying agricultural effluent to land at a rate that matches the soils capacity to absorb and treat it, are part of the package to reduce the effects of land use on both surface water and groundwater.

To be effective, riparian management needs to work alongside other work the Council is doing to promote the sustainable management of the Region's resources, and the restoration of ecological processes and biodiversity must remain realistic. It will not be possible to recreate the high shade, low temperature, luxuriant forest ecosystems that existed in the river valleys before humans settled in the Region in anything but a few special areas. However, there is ample evidence of the proven success of riparian management in improving stream conditions and increasing biological diversity. The key factor is time. It takes time to implement, and time for nature to begin to reassert itself; but the wait is worthwhile.

Appendix 1. Relevant policies from the RPS and regional plans

Policy 8 of the Freshwater Chapter of the Regional Policy Statement is

To promote the retirement and planting of riparian margins for the purposes of maintaining or improving the structural integrity of the beds and banks of water bodies, flood management, maintaining or enhancing water quality, and encouraging the healthy functioning of aquatic and riparian ecosystems.

In determining catchments, subcatchments, or reaches of water bodies to which this policy might apply, to have regard to the following:

- (1) Any existing inferior water quality (including high water temperatures, and nitrate and dissolved phosphate levels);
- (2) Any existing inferior habitat quality (including instream habitat);
- (3) The potential of land uses to affect water quality and their proximity to a watercourse;
- (4) The actual or likely contamination from non-point source contamination;
- (5) The extent of any bank degradation, erosion, or loss of vegetation;
- (6) The actual or potential uses made or to be made of the water body;
- (7) The actual or potential amenity values of the water body (including scenic and recreational values);
- (8) Any relevant Maori spiritual or cultural values; and
- (9) Any significant flora or fauna in the water body.

Methods 30 to 33 of the Freshwater Chapter of the Regional Policy Statement direct the Council to —

- identify where adverse effects on water bodies can be addressed by territorial authorities
- identify waterways that would benefit from managed riparian margins
- encourage landowners to create and manage riparian margins
- manage our own land to control non-point contaminant sources

Methods 8.4.10 to 8.4.14 of the Regional Freshwater Plan direct the Council to —

- involve the community in identifying priority areas that would benefit from improved riparian management
- provide technical support and advice to landowners
- prepare a booklet for landowners about the benefits and costs of riparian management techniques
- investigate other means for providing riparian zones in severely degraded areas
- implement appropriate riparian management practices in areas under the management or ownership of the Council.

Method 6.1.6 of the Regional Soil Plan directs the Council to —

- produce and distribute riparian management guidelines for landowners.

The Council's work to improve water quality and protect ecosystems in addition to the riparian management programme includes —

- Care groups for streams, rivers, and wetlands under the Environmental Education Initiative (EEI).
- Ecological restorations undertaken by Council staff and related organisations (e.g., Te Whiti Park, Waikanae River, Kaiwharawhara Stream, Kakaho and Horokiri estuaries) under the RPS implementation programme;
- Trees for Survival;
- School “adopt-a-stream” projects;
- Community monitoring projects;
- Pollution prevention through the Business Bridges Programme of the EEI;
- Stream clean-ups (ad hoc work days, litter removal etc);
- Wetland grants under the RPS implementation programme;
- Flood protection river corridor enhancements;
- River clean-ups (major works such as on the Waiwhetu);
- Existing wind and soil erosion plantings along river banks;
- Restoration of high value ecosystems on Council land (e.g., Rimutaka Incline riparian planting);

Appendix 2. Pilot programmes

A2.1 Purpose of the pilot programme

The purpose of the pilot programmes is to demonstrate the benefits of appropriate riparian management on aquatic ecosystems and the wider environment and to test and refine the Council's ability to implement riparian initiatives. Three streams have been selected for the programme.

1. The **Karori Stream**, a Wellington urban stream whose upper catchment is affected by residential stormwater runoff and whose stream banks are infested with weeds. This is a staged project down the length of the stream running through the bike park. The stream banks require extensive weed control and will then be planted with native plants by volunteers from the Makara Peak Mountain Bike Park Supporters.
2. The **Kakariki Stream**, a Kapiti Coast sand country tributary of the Ngarara Stream whose mid catchment is affected by residential stormwater runoff, lack of shade and stock damage to banks and water. This stream is being retired from stock access with permanent fencing and planted with predominantly native vegetation by the landowners and volunteers from Forest and Bird and Paraparaumu College.
3. The **Enaki Stream**, which is a tributary of the Mangaterere River, is a central Wairarapa plains stream whose mid to lower catchment is affected by lack of shade, stock damage to banks and rural runoff. This stream is being retired from stock access with permanent fencing and planted with predominantly native vegetation.

The streams are in both urban and rural environments to demonstrate different kinds of riparian management. The sections of streams in the three pilot programmes were classified using a stream type classification technique.¹⁸ This is so that the kind of riparian zone management adopted is appropriate to the stream type while achieving our wider purposes of halting the decline of biodiversity and involving communities in environmental care.

A2.2 Pilots as demonstration sites

As part of our provision of information, the Council will hold workshops and field days at the pilot streams. These will show why particular management techniques were adopted for each site, how to do it, the benefits of riparian management for that stream, and how the Council can support landowner initiatives.

There is plenty of evidence in the literature showing that appropriate management of riparian margins benefits aquatic habitat and water quality and the wider stream environment. These benefits are not well recognised in the wider community.

¹⁸ Quinn, J. (1999). *Towards a Riparian Zone Classification for the Piako and Waihou River Catchments*. EW Technical Report TR99/16, Environment Waikato.

The potential benefits of three riparian management options were estimated for each of the three pilot streams (see Table 3 in Appendix 3). These streams will be monitored over the next three years to test the validity of these projected benefits, and to refine the Council's approach to promoting riparian management, if this is necessary.

The monitoring results can also be used to refine Staff Guidelines describing riparian management options for particular sites. For example, we may need to take different approaches if some techniques are not achieving the purpose of the Strategy. Further, when the Freshwater Ecosystems studies are completed over the next two years, we may find that we need to develop more specific riparian management options for particular sites to enhance aquatic habitat.

Appendix 3. Assessing the benefits and costs of riparian management

A3.1 Quantifying the benefits

Table 3 shows benefit estimates of applying two kinds of riparian management options to the stream sections in the pilot programmes (see Appendix 2). These riparian management options are First Steps (taken here as stock exclusion only) and Best Practice, where riparian management is designed for desired outcomes for the particular section of the stream in the pilot.

The scores range from a low score of Bad, up to Poor, Av (average), Good, and finally Ex (excellent). The scores in this Table will be compared to an assessment of the stream after three years of being in the pilot programme.

Table 3 Relative achievement of benefits caused by riparian management options

Benefit	Karori Stream			Ngarara Stream			Enaki Stream		
	Now	FS	BP	Now	FS	BP	Now	FS	BP
Biodiversity value									
Aquatic habitat	Poor	—	Poor	Poor	Av	Good	Good	Good	Ex
Bird habitat	Poor	—	Ex	Poor	Poor	Ex	Poor	Poor	Good
Plant habitat	Poor	—	Ex	Poor	Av	Ex	Poor	Poor	Good
Recreation									
Eeling	Poor	—	Av	Av	Av	Good	Poor	Poor	Av
Trout	Poor	—	Poor	Poor	Poor	Poor	Av	Av	Good
Whitebait	NA	—	NA	Poor	Av	Ex	NA	NA	NA
Water contact	Poor	—	Poor	Poor	Av	Good	Av	Av	Av
Aesthetic	Poor	—	Ex	Poor	Av	Ex	Poor	Av	Ex
Ecosystem services									
Pollution control	Poor	—	Poor	Poor	Good	Good	Av	Av	Good
Stable banks	Good	—	Good	Poor	Av	Good	Poor	Av	Good
Landowner benefits									
Shelter and shade	Poor	—	Good	Bad	Bad	Good	Poor	Av	Good
Stock water	NA	—	NA	Poor	Av	Av	Av	Good	Good
Flood control	—	—	—	—	—	—	—	—	—
Bequest	—	—	—	—	—	—	—	—	—
Cultural	—	—	—	—	—	—	—	—	—

A score moves one step up the scale (for example from good to excellent) if the change is thought to be noticeable. “Bad” is the worst possible state, and “excellent” is the best possible state, given the surrounding land use. That is, if surrounding land is used for productive farming, an excellent rating means that the score is the best possible within this environment.

The bequest value has not been scored because it is too complicated for this study. The cultural benefits have not been scored because Iwi have not yet been consulted.

This assessment shows that scores rarely move more than one step up the scale of stream improvements if the First Steps option is implemented, whereas they move up to four steps up the scale if the Best Practice option is implemented.

A3.2 Quantifying the costs

Table 4 shows cost estimates of applying four kinds of riparian management to a stream. These options are

- streams planted (poplars or willows), but with continued stock access
- temporary stream retirement, such as electric fencing
- full stream retirement from stock with exotic vegetation planted
- full stream retirement from stock with native vegetation planted.

Table 4 Estimation of relative costs of applying various riparian management options to 100 kilometres of stream

	Stream planted and grazed (\$ '000s)	Temporary stream retirement, some grazing (\$ '000s)	Stream retired (2.5m), planted with exotic seedlings (\$ '000s)	Stream retired (5 m), planted with native plants (\$ '000s)
Material costs				
Electric fence		300		
Permanent fence			960	960
Stock water trough		465	464	464
Stock crossing		300	300	300
Protected poplar or willow poles	315	315		
Seedling planting (exotics)			80	(160)
Native Plants			(312)	625
Labour costs				
Electric fence		390		
Permanent fence			1,415	1,415
Planting	95	95	40	125
Weed control			70	140
Water supply		48	48	48
Lost opportunity costs				
	—	—	—	—
Total estimated cost	410	1,913	3,377	4,077

The estimations assume that the stream margin has no existing fences or desired vegetation, that adjacent paddocks are used for dairy farming and that stream retirement will necessitate the installation of stock water supplies in every paddock. Actual costs will be lower than these estimations because some streams are already fenced off and many dairy farmers already have separate stock water supplies.

The material and labour costs for fencing are taken from WRC Soil Conservation cost estimates for sites of moderate difficulty, with both sides of the stream fenced (\$11,875 per km per side). The material costs for stock crossings assume that a new crossing is required for every kilometre of stream retired. Stock water supply assumes eight stock water troughs per kilometre of stream (4 each side) at \$580 per trough. Estimated costs for non-dairy farmers are based on two stock water troughs per kilometre of stream.

Planting labour costs are based on 20 plants planted per hour at \$10.00 per hour. Plant costs are estimated as

- pole planting: 200 x 3 metre poles per margin hectare @ \$7.85 per plant
- seedling planting (poplars and willows): 1600 stems/ha @ \$1.00 per plant
- native plants: 2500 plants/ha @ \$2.50 per plant

Lost opportunity costs arise because some kinds of riparian management remove some kinds of land from productive use or recreational use. The costs associated with this loss have not been calculated because it is too complicated for this study. For example, lost production doesn't apply to land in urban areas, and in rural areas the lost opportunity costs depend on the actual amount of production lost, and the value of that production. The 219 dairy farms in the Wairarapa part of the Region, for example, produce 470 kg milkfat per effective hectare, on average,¹⁹ but not all lost dairy land beside streams would have this production value, and not all land beside streams is used for dairy farming.

The estimations show that the greatest cost associated with stream retirement is for permanent fencing (70% for a planted riparian width of 2.5 m). For wider fenced riparian areas, the actual fencing costs stay the same, but plant and weed control costs increase. For a fenced and planted riparian area with an average width of 5 metres on both sides of the stream (one hectare per kilometre), the material costs of exotic plants make up about 4% of the overall cost, cf. 15% if native plants are planted. These percentages increase to 9% and 27% if the riparian width is increased to 10 metres (two hectares per kilometre).

Riparian management of urban streams does not incur costs for stock water supply, bridges, or fencing, but the weed control costs will generally be much higher. For example, weed control on the Kaiwharawhara Stream near Wilton Bush in Wellington requires management of 20 metres on both sides of the stream at an overall cost of over \$8,000 for one kilometre of stream. The

¹⁹ Livestock Improvement Corporation Ltd (2000). *Dairy Statistics 1999-2000*.

approximate minimum costs for urban streams are therefore, \$6,250.00/ha for plants and \$2,000/ha for weed control. If volunteer planting labour is counted as a contribution of \$1,250.00/ha, the volunteers' contribution amounts to 13% of the overall cost.

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