

ENVIRONMENTAL CONSIDERATIONS FOR CLEAN STREAMS

A guide to managing waterways in Otago



Note: *This booklet provides information on how best to manage waterways in Otago. The advice provided is generic for all farms and may require some adaptation for your particular farm. Otago Regional Council rules covering activities in and around waterways are also summarised within the booklet. Please note that these are as a guide only. You can find the complete wording for all rules in the appropriate plans available from the Otago Regional Council.*

Contents

Foreword	2	Managing Open Drains	38
Introduction	3	Managing drains to reduce maintenance	39
Waterway Management Basics	4	Low impact mechanical drain clearing	40
How agriculture affects waterways	5	Low impact chemical spraying	42
Checking water quality in your local waterway	6	Low impact hand clearing of drains	42
Managing riparian margins well	6	Managing Weeds and Pests	43
Practising good farm management	8	Managing weeds along fenced waterways	43
Four key approaches	9	Managing weeds in planted riparian margins	44
Fencing Stock out of Waterways	12	Controlling animal pests	45
What will it achieve?	12	Agrichemical Use near Waterways	46
Adding a grass buffer strip	13	Ways to avoid impacts	46
Questions about fencing	14	What do I do if a spill occurs?	47
Coping with floods	16	Otago Regional Council Rules	48
Temporary fencing	16	Rules affecting agrichemical use	48
Managing waterways without fences	17	Rules affecting culvert and bridge construction	50
Stock watering options	17	Rules affecting drain management, floodbanks and floodways	51
Planting the Riparian Margin	18	Rules affecting fencing along waterways	52
Plan well to meet your goals	19	Rules affecting in-stream works and willow removal	52
When bank erosion is a problem	20	Rules affecting stock access to waterways	53
Using trees to stabilise stream banks	21	Rules affecting tree planting along waterways	53
Prepare a planting plan	22	Rules affecting weeds and pests	54
Planting guide	23	Rules affecting wetlands	54
Continuing maintenance	27	Pulling the Threads Together	55
Managing Wetlands, Seeps and Swamps	28	Appendix 1:	
What can managed wetlands achieve?	29	Useful Contacts and Assistance	56
Excluding stock temporarily from wet areas	29	Appendix 2:	
Managing your natural filters	30	Native Plant Lists for Otago	58
In-Stream Works and Willow Removal	31	Reference List	86
Avoiding negative effects on the waterway	31	Acknowledgements	88
Removing willows	32		
Stream Crossings	33		
Stock crossings are good for business	33		
Getting culverts right	34		
Building sound bridges	35		
Bringing Back Fish and Waterfowl	36		
What do native fish need?	36		
What do sports fish and waterfowl need?	37		

Foreword



Stephen Cairns

Water is a key resource within Otago, one that will shape the future development and prosperity of our region. What happens in Otago depends on how clean we keep our natural resources, how efficiently we use our water, and how well we manage it to meet habitat and environmental needs.

Over the past few years the Otago Regional Council has been active in monitoring water throughout the region. Unfortunately the quality in some of our streams and rivers is not as good as it could be, and considerable work is required to bring them up to an acceptable standard. Despite this, I am encouraged by reports that progress is being made, and that many landowners are taking the initiative and ensuring that their operation does not contribute to the problem.

To a large extent the quality of water in our streams and rivers depends on what happens on the banks. Sound riparian management helps minimise the environmental risks presented to our waterways by many land-use activities. The Otago Regional Council is committed to ensuring an improvement in the quality of water in our streams and rivers, and the production of this booklet is part of this process.

The booklet contains detailed information and tips on how to manage our waterways, including the basics of waterway management; fencing and planting of riparian margins; managing in-stream works and open drains; and weed and pest management. It also contains a summary of the Regional Plan: Water rules relating to waterway management.

This is an update and rewrite of our 1996 booklet and I acknowledge the help of Environment Waikato and Dexcel for their knowledge and input into this version. I also extend a big thank you to local groups and organisations for their thoughts and contributions. Through this combined effort we now have an excellent guide to ensure that our waterways become what they should be – clean, clear and a source of recreational pleasure.

Stephen Cairns
Chairperson
Otago Regional Council

Introduction

If looking after your farm business and your local environment is important to you, it is time you checked your waterway management. Well-managed waterways could help you meet market demands, enhance your farm and stock management, and protect water quality and freshwater life into the future.



A well planted riparian margin

Animals commonly have direct access to streams and rivers, where they can damage natural habitat, erode banks and reduce water quality. Monitoring shows that some streams and rivers are periodically unsafe for recreation because bacteria levels are very high, with many bacteria coming from farm runoff and stock faeces in waterways.

However, the news is not all bad! There are many examples in Otago of profitable farming businesses adopting good environmental management and reducing their negative effects on waterways.

Many of these farmers say this benefits their farm by:

- ▶ reducing stock losses
- ▶ reducing bank erosion
- ▶ conserving soil, and
- ▶ improving stock health.

This booklet explains how to manage waterways to improve water quality, freshwater life and bank stability, as well as enhance your farm. Choose an approach to suit your own farm and environmental goals, budget, and the types of waterways on your farm.

This booklet also provides a summary of rules that may apply to waterway management, but this is intended as a guideline only. You can find the complete wording for all the rules in the appropriate plans available from the Otago Regional Council.

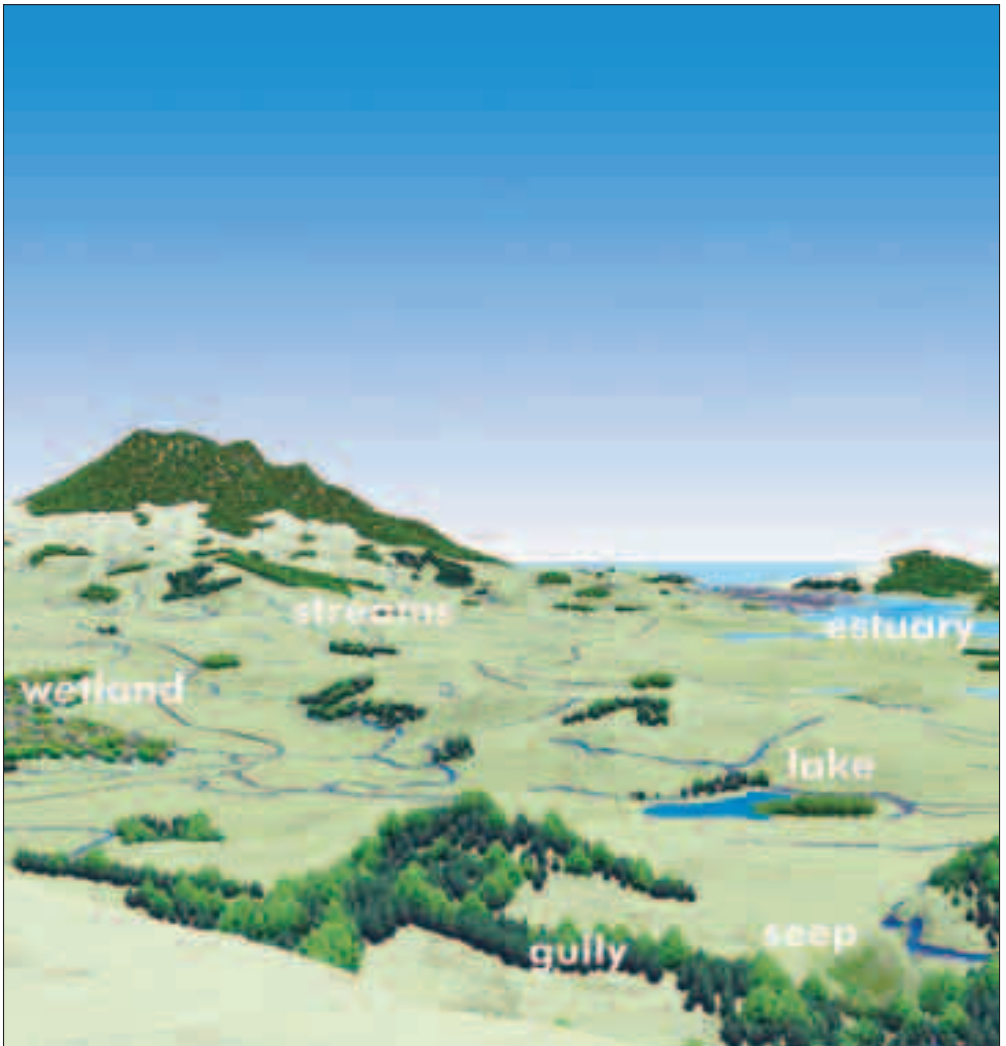
This booklet does not cover issues that are affected by plans produced by your city or district council.

You can get further information from a variety of sources including nurseries and private consultants, environmental groups, the Department of Conservation, local City or District councils and the Otago Regional Council.

The Otago Regional Council can provide you with advice and information about managing your waterways, as well as advice on best management practices across your whole farm. Contact us on 0800 474 082 for more information.

Waterway Management Basics

Waterways include rivers, streams, creeks, drains, ponds, lakes, wetlands and estuaries. It's also important to include gullies, which are often dry but will channel runoff into main waterways during wet periods.



Examples of waterways in a farming catchment

How agriculture affects waterways

One of the first steps towards better waterways on your farm is to understand more about how farming can affect them.

Farms contribute four main pollutants – nitrogen, phosphorus, sediment and

faecal matter (containing bacteria and viruses). The table below shows why these pollutants are problems and how they get from paddocks to waterways.

Farm Sources of Waterway Pollutants

Pollutant	Why it is a problem	Source of pollutant	How it gets to water
Nitrogen (N)	<ul style="list-style-type: none"> ▶ Feeds nuisance plant and algae growth in waterways ▶ Algae and nuisance plants affect stream life, block water intakes and make water unpleasant for swimming and drinking ▶ Ammoniacal nitrogen can be toxic to fish 	<ul style="list-style-type: none"> ▶ Urine and dung from stock ▶ Nitrogen in fertiliser ▶ Farm dairy effluent 	<ul style="list-style-type: none"> ▶ Moves down through soil (leaching) into groundwater and subsurface drains, which feed into streams ▶ Surface runoff ▶ Stock in streams ▶ Discharges from oxidation ponds
Phosphorus (P)	<ul style="list-style-type: none"> ▶ Feeds nuisance plant and algae growth in waterways ▶ Algae and nuisance plants affect stream life, block water intakes and make water unpleasant for swimming and drinking 	<ul style="list-style-type: none"> ▶ Dung from stock ▶ Phosphate in fertiliser ▶ Farm dairy effluent ▶ Soil sediment 	<ul style="list-style-type: none"> ▶ Soil and bank erosion (P binds to soil particles) ▶ Surface runoff ▶ Discharges from oxidation ponds ▶ Stock in streams ▶ Subsurface drains
Sediment	<ul style="list-style-type: none"> ▶ Makes water murky and affects stream life ▶ Poor water clarity makes water unsafe for swimming 	<ul style="list-style-type: none"> ▶ Slips ▶ Stream bank erosion and trampling ▶ Tracks and races ▶ Surface of paddocks 	<ul style="list-style-type: none"> ▶ Surface runoff ▶ Stream bank collapse ▶ Slips
Faecal matter (bacteria, viruses)	<ul style="list-style-type: none"> ▶ Human health risk from swimming and drinking ▶ Can affect stock health if present in stock water 	<ul style="list-style-type: none"> ▶ Dung from stock ▶ Farm dairy effluent 	<ul style="list-style-type: none"> ▶ Stock in streams ▶ Subsurface drains ▶ Discharges from oxidation ponds ▶ Surface runoff ▶ Poorly managed effluent irrigation

Checking water quality in your local waterway

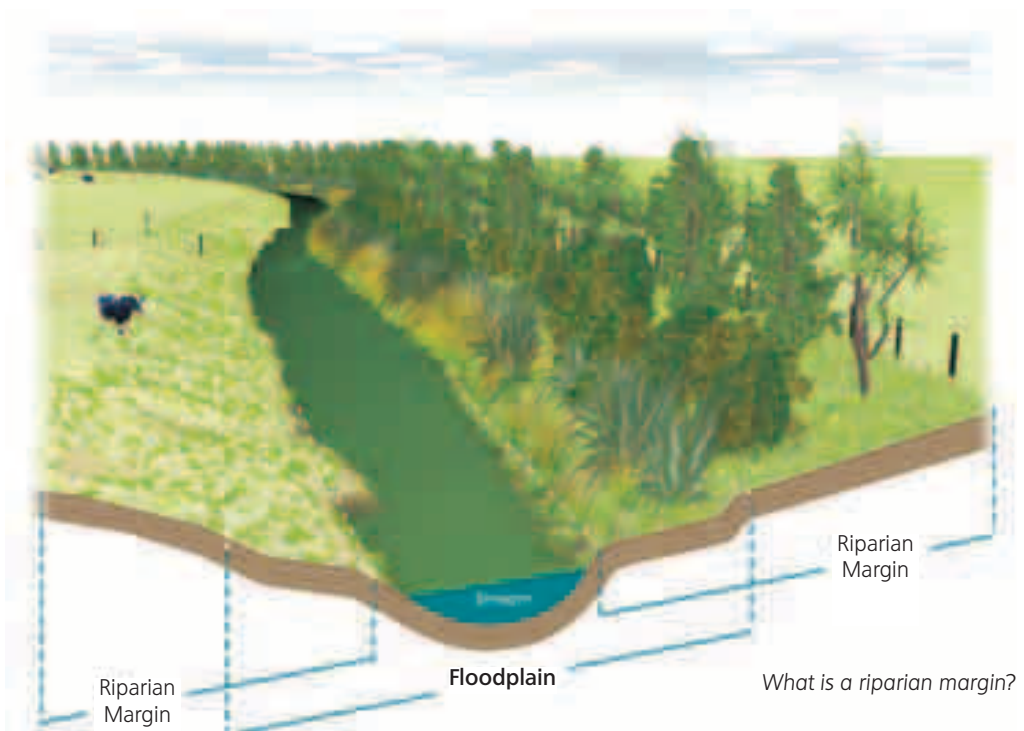
For water quality information for your farm, either:

- ✓ Ring the Otago Regional Council on 0800 474 082 and ask for information on water quality in your catchment, or
- ✓ Ring the Otago Regional Council land resource section and ask to borrow a Stream Health Monitoring and Assessment Kit (SHMAK) and check your local waterway yourself. Borrowing this kit is free.

Managing riparian margins well

Riparian margin: the area beside waterways that forms the interface between water and land.

This area is a crucial buffer between land use activities and the natural waterway. Well-managed riparian margins are free from stock damage and have a grass sward or trees and shrubs present to perform a number of important roles.



Well-managed riparian margins protect water quality by:

- ▶ Filtering surface runoff
- ▶ Taking up nutrients (through plant roots)
- ▶ Removing nitrogen (bacteria in wet riparian soils can remove nitrate nitrogen from groundwater, releasing it to the atmosphere as nitrogen gas)
- ▶ Preventing stock access when they are fenced (reducing bank trampling and direct inputs to waterways of sediment, nutrients and harmful faecal bacteria).

Riparian margins can provide food and habitat for freshwater life, for example:

- ▶ fish habitat – inanga spawn in grassy areas in the lower floodplain. Fish seek cover under overhanging vegetation
- ▶ leaf litter – important food for aquatic animals
- ▶ shade – important for reducing water temperature for sensitive freshwater life. Shade also reduces the growth of nuisance plants in waterways.

Well-managed riparian margins improve biodiversity by providing:

- ▶ for more diverse plant and animal communities
- ▶ important native wildlife corridors and habitat

Managing riparian margins can also provide direct farm benefits by:

- ▶ stabilising banks
- ▶ reducing stock losses by excluding stock from waterways
- ▶ enhancing the farm landscape
- ▶ reducing the need to clear drains and streams
- ▶ making stock and grazing management easier.



Whitebait

Practising good farm management

Prevention is better than cure!

Riparian margins provide the last opportunity to keep farm pollutants out of waterways but good management across the whole farm will help reduce pollution at its source, as well as enhancing your business.

- ✓ Graze carefully in wet weather to avoid pugging, pasture damage and soil erosion.
- ✗ Avoid overgrazing steep slopes and areas beside waterways.
- ✗ Avoid feeding out supplements beside waterways or on river or lakebeds.
- ✓ Provide shade, shelter and water troughs for stock, away from waterways
- ✓ Apply fertiliser with care, especially near waterways.
- ✓ Manage farm dairy effluent effectively.
- ✓ Carefully manage stocking rates, fertiliser and effluent applications, especially if the farm has extensive tile drain networks or is within groundwater protection zones (see the Regional Plan: Water for location of groundwater protection zones in Otago).
- ✓ Leave a buffer strip between a cultivated paddock and the waterway to trap sediment and reduce runoff.
- ✓ Minimise runoff from tracks and races by providing cut-offs into grassed areas.
- ✓ Consider retiring steeper headwaters and reforesting or planting a timber crop.
- ✓ Prevent silage leachate from reaching waterways.

- ✓ Retain wet swampy areas as sponges and filters.
- ✓ If you plan to strip graze green feed crops, choose paddocks away from waterways or avoid cultivating close to waterways. Use electric fences to keep stock back from waterways when you graze these crops.



Cultivating leaving a buffer strip along a waterway

For more information about farm management practices for better environmental outcomes, ask your farm advisor or contact Otago Regional Council on 0800 474 082 for a copy of one of the following booklets:

- Environmental considerations for dairy farming in Otago
- Environmental considerations for intensive sheep, beef and arable farms in Otago
- Environmental considerations for managing dairy effluent in Otago
- Environmental considerations for lifestyle block owners in Otago

Four key approaches

Research in New Zealand and overseas has identified four key approaches to managing riparian margins on farms to achieve better water quality, enhanced freshwater life and better biodiversity along the banks.

✓ **Keeping animals out**

Fencing stock out of rivers, streams, drains, wetlands, lakes and estuaries

✓ **Maintaining a grass buffer strip**

Maintaining an ungrazed grass strip beside waterways, of at least one metre wide on flat land and wider on sloping land.

✓ **Planting the riparian margin**

Planting vegetation beside waterways in a fenced ungrazed strip of at least five metres.

✓ **Managing wetlands**

Managing wetlands, seeps, swamps and gullies to exclude stock during crucial periods.

Some farms may suit a mix of all four approaches while on others it may be better to focus on just one. Different approaches can achieve different benefits for your farm business, water quality, freshwater life and waterway banks. Success will depend on how you manage the riparian margin, surrounding and upstream land.



A simple fence keeps animals out

The benefits of different waterway management approaches

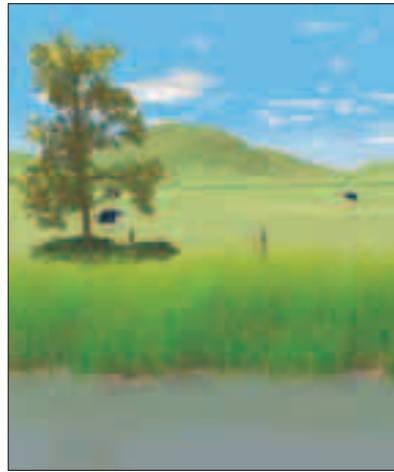
Animals Out



Benefits

- Reduces faecal bacteria in the water.

Fenced grass riparian margin



Benefits

- Reduces faecal bacteria in the water
- Helps keep bank stable
- Filters P and sediment from runoff
- Filters ammonia from runoff.

Replanted native riparian margin



Benefits

- Reduces faecal bacteria in water
- Balance of shade and grasses can help keep the bank stable
- Improved habitat for fish and aquatic life
- Habitat for native birds, insects and plants.

Managed wetlands



Benefits

- Reduces faecal bacteria in the water
- Filters out some P and sediment from runoff
- Removes N from runoff and resurfacing groundwater.

Developing your action plan

Before reading more about the waterway management approaches you might take, it's helpful to think about what you want to achieve.

Here are some questions to think about when planning and considering realistic goals for your farm

- ▶ What do I value about the stream, drain, river, lake, wetland or estuary on my farm?
- ▶ What, if anything, is wrong with the condition of the waterway?
- ▶ How is my farm contributing to the condition of the waterway?
- ▶ What things are most important to me to protect or improve about the waterway (e.g. freshwater life, water quality, stable banks)?
- ▶ Do I have a significant river, stream or wetland that I should be protecting?
- ▶ What management approaches listed in this booklet will help improve the waterway to meet my priority goals?
- ▶ What challenges am I likely to face in managing riparian margins on my farm and how can I best plan to deal with those challenges (e.g. flooding, pests)?
- ▶ What are the costs and benefits to me of managing waterways? Where are the areas on the farm that will give the biggest benefit for the least cost?
- ▶ How does waterway management fit in with other farm priorities?
- ▶ How will my management affect land downstream?
- ▶ How will upstream activities affect me?
- ▶ What are my neighbours doing about waterway management? Could we work together (e.g. in a landcare group)?
- ▶ How much time do I have to maintain my riparian margins?

- ▶ What resources (incentives and advice from agencies, funding organisations, community groups and the farming industry) are available to help me with waterway management?

You might choose to do a little bit each year at critical places on the farm. This way you can learn what works best for you and your farm, and keep up with maintenance more easily. This booklet can help you work out your waterway management priorities and plan effective ways to meet your goals.

Steps to effective waterway management

1. Identify the main waterway management issues on your farm.
2. Set goals and objectives, and choose an approach (or combination of approaches) to achieve these.
3. Estimate the costs involved.
4. Seek advice if needed (from the Otago Regional Council, farm advisors, nurseries etc).
5. Put your plan into action.
6. Check that you are meeting the objectives. Identify the actions that are working well and any that are not.

Change your plan if it is not achieving your objectives or if you set new goals.



Good planning helps keep you focused

Fencing Stock out of Waterways

What will it achieve?

Fencing stock out of your waterway should help you achieve:

- ▶ better water quality because less dung and sediment are directly deposited into the waterway. You'll also slightly reduce N and P going into the waterway but you'll need further changes if nutrient reduction is your main goal.
- ▶ better aquatic habitat by preventing damage to the bed and reducing sediment.
- ▶ more stable banks by preventing treading and erosion.
- ▶ farm benefits such as reduced stock losses in waterways (drowning and bogging), faster/smoothed paddock clearance of stock and reduced drain maintenance costs (less silting).



Single wire fence to keep cows out of the waterway

Adding a grass buffer strip

Fencing the waterway is valuable but you'll get greater benefits by leaving an ungrazed grassy strip between the fence and waterway. Fencing right beside the waterway (i.e. less than one metre away) only keeps stock out but a strip more than one metre wide will lead to:

- ▶ improved water quality and in-stream habitat by filtering sediment, phosphorus, ammonium and faecal matter out of surface runoff. Up to 90 percent of sediment can be caught in an effectively constructed filter strip.
- ▶ improvement in bank stability by having a protective grass cover and no stock access to the bank edge.

The effectiveness of a grass riparian margin depends on:

- ▶ the type of vegetation – a dense grass sward is the best filter. Exotic grasses, native sedges and rushes are most effective for removing sediment, bacteria and nutrients from surface runoff on relatively level ground. Long dense grass slows runoff so that sediment, phosphorus and faecal matter can settle out.
- ▶ soil porosity – water may seep rapidly through very porous soils, taking soluble nutrients into waterways.
- ▶ the width of the margin – within reason, the wider the better!
- ▶ land slope beside the waterway – if it is steep, the grass margin needs to be wider or may not be the best management option. Consider alternative land uses to reduce erosion and adopt careful pasture, stock and farm track management.
- ▶ tile and mole drains reduce the margin's effectiveness because excess nutrients bypass the margin by leaching through the soil to the drains and thus to waterways.



A well-managed grass stream margin

Where is a fenced grass margin most effective?

Grass riparian margins will be most effective at improving water quality:

- ▶ along drains, small lowland streams and around ponds and lakes
- ▶ in areas with significant surface runoff
- ▶ through paddocks that are strip grazed in autumn and winter
- ▶ in the hilly upper reaches of streams
- ▶ beside vegetated drains in areas with poor soil drainage or pugging and moderate slopes
- ▶ where paddocks are cultivated.

Questions about fencing

What sort of fence is best?

Your decision will depend on the stock classes you run. A two or three wire electric fence with permanent posts is usually the best option for dairy cattle. Four electric wires may be enough for sheep but will need maintenance to remove vegetation from the riparian side (to maintain voltage). A gate to remove animals that do get through is a good idea.



7 wire post and batten permanent fence may be appropriate in some situations

Where best to put the fence?

There are pros and cons to either following the bends of waterways or putting in a straight fence. Straight fencing takes less

material and time but might lose more grazing, especially if you have to set the fence back further for unstable or flood prone banks. Fenced banks are less likely to collapse but you may still get flood damage.

Consider your overall farm layout. Fencing waterways is better value for money if it improves subdivision for grazing management and stock control at the same time.

What about access?

Occasionally you may need to use machinery to clean weeds, silt or debris out of drain channels. Electric fences can be dropped or removed for access but you might need to leave space between the bank edge and the fence for machines to work alongside a more substantial fence. Leaving this space on one side of the channel (rather than both sides) may be enough but if the drain forms a boundary between two properties, then access from both sides will be needed so cleaning can alternate between properties.

How wide should the margin be between fence and waterway?

In general, the steeper and longer the slope that feeds into the waterway, the wider the grass margin needs to be. New Zealand research recommends that for gently rolling land, widths of one to three metres per 100 metres of slope feeding into the waterway are ideal. On steeper slopes and poorly draining soils, a grass margin of 10 to 15 metres per 100 metres of adjacent slope is recommended.

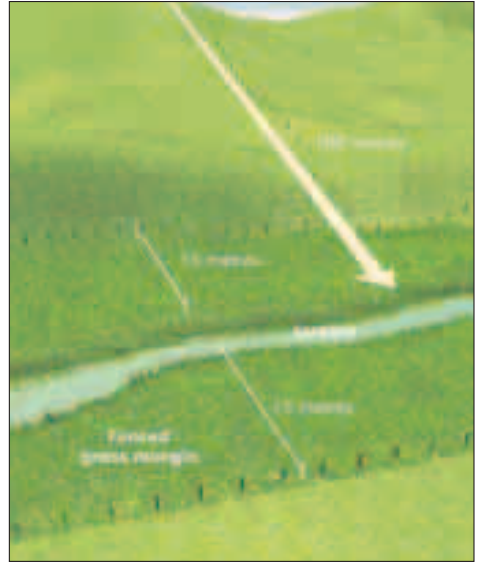
For example, in a relatively flat area, such as the Taieri Plains, with a 100 metre flat or slightly rolling slope feeding into the waterway, a margin of one to three metres would be enough. Steeper areas like the hill country around Lawrence, with the same length slope, would be better with a margin width of 10 to 15 metres for maximum filtering (see page 15).

Working out how wide your grass riparian margin needs to be

Gently Rolling Land



Steeper Land



Using grass margins to filter channelled runoff



Often runoff flows in defined channels across paddocks to reach waterways. Wider grass margins are better in areas where you know runoff is channelled into waterways during times of high rainfall and runoff.

On hill country farms with long slopes, wide margins are most effective across these drainage channels.

Narrow grass strips where a fence is very close to a waterway provide little filtering. Consider temporary fencing for a wider strip during wet periods.

Coping with floods

Flooding can be a major problem. Simple one or two wire electric fences are less likely to collect flood debris and be swept away and are easier to stand back up after a flood.

Flooding can cause expensive damage for drystock farmers with seven to nine wire, post and batten fences. Some ideas to reduce the damage and cost of repairs:

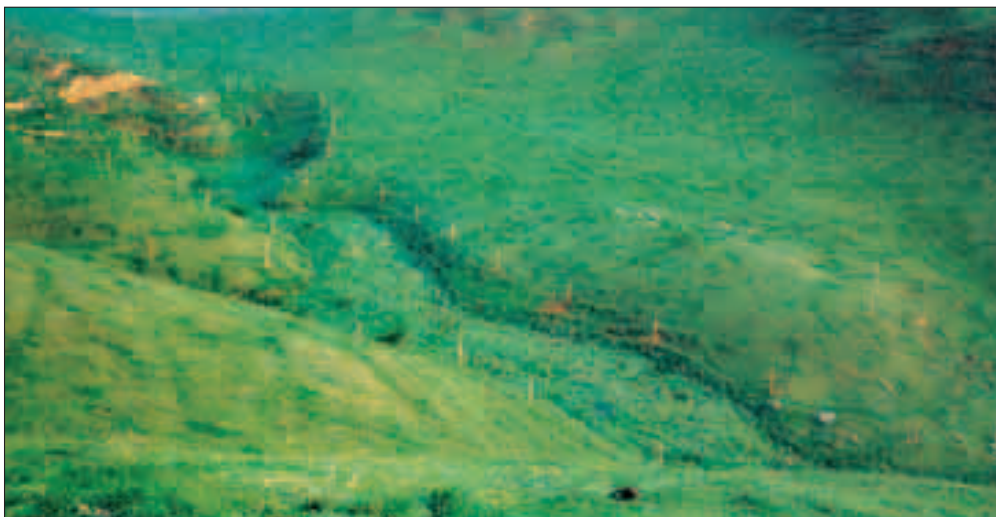
- ✓ Try five wire electric fencing along the most flood prone sections.
- ✓ Construct separate 'blow-out' sections across flood channels.
- ✓ Put fence wires on the downstream side of posts so they pop their staples and drop rather than breaking.
- ✓ Use un-barbed staples so wires can pop more easily.
- ✗ Avoid using battens in flood prone sections to reduce snagging.
- ✓ Consider putting your fence further away from the waterway, especially on the outside bends of rivers and streams with high erosion potential.

- ✓ Think about the height of the bottom wire in relation to expected flood levels and record the flood height after major floods to help with the placement of waterway fences in the future.

Temporary fencing

You can protect sensitive areas at critical times with temporary electric fences – e.g. using a tape fence around wet areas and seeps in winter, especially when strip grazing greenfeed crops. This will avoid soil damage and runoff, and protect the future productivity of the paddock. The temporary fence provides a wider vegetative filter for runoff and reduces the chance of stock getting bogged.

Temporary electric fencing can also be used on slopes to keep cattle out of springs and wet areas that drain towards a stream. The grass in the fenced area can filter dirty runoff from pugged pasture upslope, before it reaches the stream. Remove the fence and graze when the soil is drier.



Keeping stock out of seeps helps filter runoff

Managing waterways without fences

It may not be practical to fence all your farm's waterways. Options for better management without fencing include:

- ✓ Provide troughs with clean water away from waterways.
- ✓ Provide shade and shelter away from waterways.
- ✓ Keep stock numbers lower in paddocks with waterways to minimise damage.
- ✗ During wet periods avoid grazing paddocks with unfenced waterways.
- ✓ Graze sheep, young stock or lighter stock in paddocks with waterways.
- ✓ Monitor grazing and move stock if they start to damage banks.
- ✓ Put in crossings where stock naturally cross the waterways.

Stock watering options

Fencing off waterways may remove a source of stock water. A reticulated stock water system can be expensive but will improve stock health and productivity. Stock can pick up a large variety of bacteria and viruses from drinking water contaminated by animals and their waste. Reticulated systems also allow you to deliver animal remedies and supplements.

Rules affecting fencing stock out of waterways

Check the Rules chapter of this booklet for relevant rules including:

- Rules affecting fencing along waterways
- Rules affecting stock access to waterways
- Rules affecting drain management, floodbanks and floodways

Sources of further information

For more information about fencing stock out of waterways, contact:

- Otago Regional Council land resource section
- Agricultural consultants

Planting the Riparian Margin

Fencing stock out of the waterway and establishing a grass margin is a great start to protecting the waterway. Re-planting the riparian margin will provide additional benefits such as:

- ▶ Providing habitat for native plants and birds, and food for fish and insects
- ▶ Keeping the waterway cool
- ▶ Filtering nutrients, sediments and faecal matter
- ▶ Improving bank stability
- ▶ Providing shade for your stock
- ▶ Creating an attractive feature
- ▶ Providing recreational opportunities such as duck-shooting and improved fishing.



Planted stream banks create a farm asset

Plan well to meet your goals

One of the secrets of successful riparian planting is to be clear about your goals and to plan your planting approach in order to achieve them.

While protecting freshwater life and local biodiversity are the key benefits of replanting, you might also want to maintain bank stability, improve water quality and enhance your farm.

Your goals will determine what plants you use and how you manage the area.



Carex secta in an Upper Taieri ox bow

In particular:

How wide should you go?

- ✓ Consider how much area you can afford to remove from grazing and replant, and where you need access gates or walkways. A width of 5-10 metres provides the best benefits for freshwater life while allowing some filtering and bank stability.
- ✓ Allow at least 10 metres to create a self-sustaining piece of bush on the edge of a waterway with minimal weed management.
- ✓ Try to link riparian margins and existing pieces of bush together to promote local biodiversity.

Reducing stream temperature

- ✓ Aim to plant and shade at least 200 metres of waterway if you want to reduce stream temperature. High stream temperatures can be a problem for stream life.

Improve water quality with an extra filter

- ✓ If you want to build a water quality filter into your replanted riparian margin to deal with surface runoff, you'll need to include a grass or sedge strip of at least one metre wide on the paddock edge.



Native sedges used to stabilise a stream bank

When bank erosion is a problem

If bank erosion is an issue on your farm, here are some practical tips to help you achieve a balance between replanting and erosion control:

- ✓ Research indicates that if you want to replant your stream bank with natives but keep your banks stable, it's important to maintain a good cover of grasses on the bank edge.
- ✓ Keep shade levels at 50 to 70 percent to make sure grasses and sedges on the bank are not shaded out. Scientists estimate this shading level occurs when the combined bank and vegetation height is about equal to the stream channel width.

- ✓ Keep shade levels low in areas where erosion is a problem.
- ✓ On small narrow streams, plant long grass or sedge species (e.g. native *Carex* species) to provide stream shade, native habitat and bank stability.
- ✓ In a wide riparian margin, plant trees back from the stream and let grasses occupy the immediate bank.
- ✓ Plant far enough back from the channel to allow for any erosion that is likely before your trees are well established.

Using trees to stabilise stream banks

Exotics

The most effective trees for stream bank erosion control are exotic willows and poplars. These are planted as stakes (less than one metre high) or poles (1.5 - 3 metres in height). Avoid invasive spreading species such as crack willow, weeping willow, silver poplar and all non-sterile tree and shrub willows. Before planting fast-growing trees, consider their longer-term maintenance needs.

Winter is the best time to plant these species, before stakes or poles sprout new growth. Plant about a third of the length below ground. On waterlogged ground, you can force them in by hand. On firm ground, you may be able to sharpen poles at one end and drive them in with a rammer or use a post auger. Stakes can be planted by putting them into a hole made with a length of reinforcing rod or similar. The most important thing is to make sure stakes and poles are firmly planted.



Poplars help stabilise a stream bank

To effectively stabilise banks:

- ✓ Pair-plant along straight reaches, so roots interlock underneath the streambed
 - one tree on one bank, one tree on the opposite bank, five to seven metres apart. This makes sure that the second tree prevents bank scour by current deflected from the roots of the first.

- ✓ Plant at two to three metre spacings at critical points, such as the outside of bends where erosion is greatest.

- ✗ Avoid planting on the inside of bends
 - soil builds up rather than erodes here, so trees will trap sediment and force current against the outer bank.

- ✗ Avoid planting narrow channels where trees might impede floodwaters.

By the time trees are four or five years old, there will be a solid mass of roots along the bank. At 10 to 20 years, trees can be thinned to 10 to 12 metre spacings but no wider. If you use 'Netlon' or 'Dynex' sleeves on poles to protect the willows and poplars, sheep can be grazed around the trees from the time they are planted.

Natives

Planting natives for bank stability will enhance the natural biodiversity of your riparian margin and provide habitat for invertebrates and birds. While exotic tree species are proven at stabilising banks, new research shows that native ribbonwood, cabbage tree and pittosporum species are suitable for bank stabilisation. These species are deep rooting with a good root spread. Planting native species alongside exotics will help maintain a mostly native planting on your banks.

Follow the planting guidelines for native plants in the Planting Guide section. When you're planting natives for bank stabilisation, plant at 1.5 - 3 metre spacings.

Prepare a planting plan

Sketch a plan of your site, jotting in the plants you want to use and when you'll plant. Use the information in this chapter to help you select suitable plants and management.

- ✓ Before planting, check out slope steepness and length beside the waterway, and areas that flood easily.
 - ✓ Consider whether you need access for waterway maintenance.
 - ✓ Think about the area you can afford to plant in any one year, including labour to keep it free from pests and weeds, especially in the first three years (see the weed and pest section of this book for more information).
- ✓ Visit your local plant nursery to find out what species they stock, costs, and how many plants you can order at a time. When choosing native plants, choose locally grown plants which will be best adapted to your conditions. Local native seed stock also helps maintain the ecological integrity of your plantings.
 - ✓ Order plants well in advance.



A well planted riparian margin

Planting guide

What to plant where

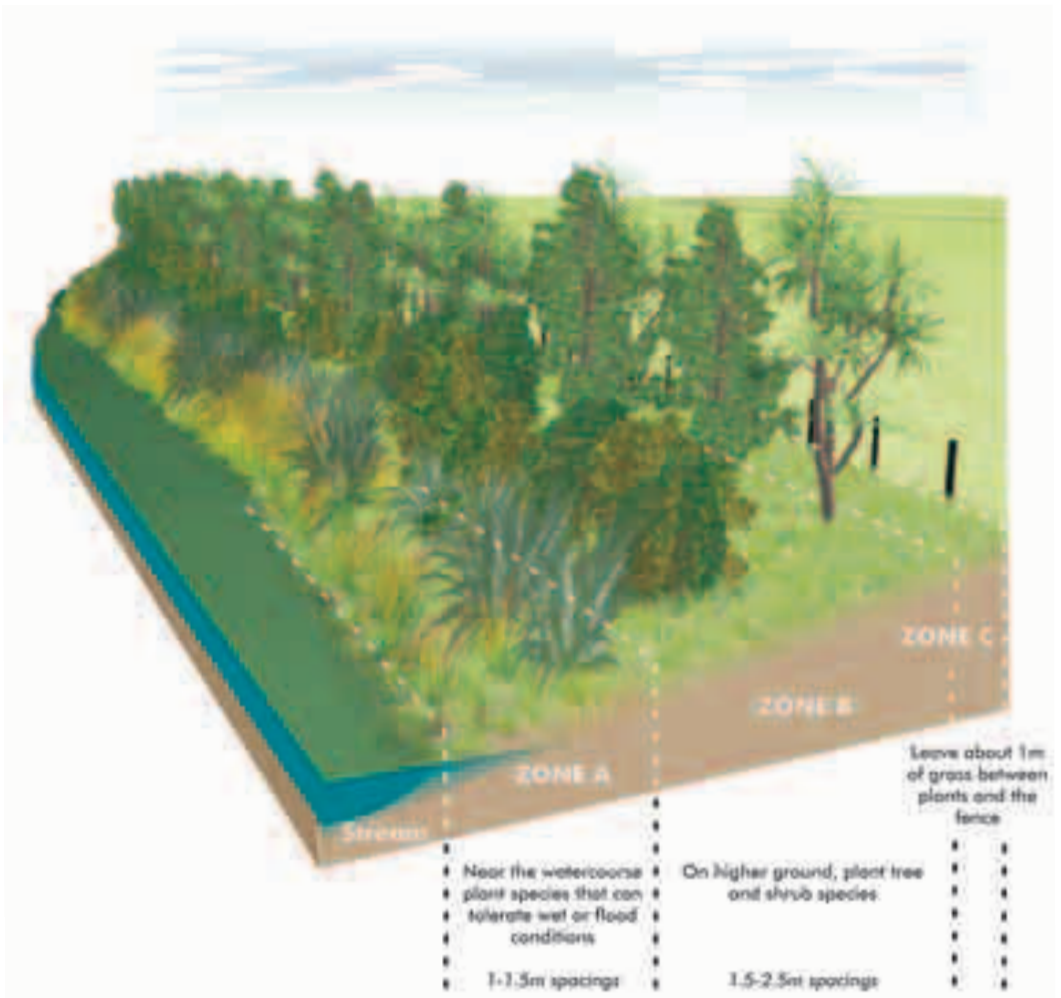
The riparian zone can generally be divided into three zones (A, B or C).

When selecting plants for your site, choose:

- species appropriate to each planting zone (A, B, C)
- species that can tolerate local frosts
- only coastal species if you're in a coastal area

- species tolerant of your site's expected soil moisture conditions
- high quality plants grown from local stock
- plants that have been well hardened to open conditions.

See **Appendix 2** Native Plant Lists for Otago.



Riparian margin planting zones

Plant Spacing

Plant spacing will depend on the size of plants you buy, how big they will eventually get, expected survival rates and how soon you wish the plants to appear established.

As a general guide, allow 1 - 3 metre spacings for native plants. At three metre spacings, you will need more weed control and more replanting to replace plants that die.

If you want your riparian margin to look established quite quickly, plant at one metre spacings. Trees with a large mature size (e.g. rimu, totara) could be planted at 5 - 10 metre spacings, with smaller species in between. Two metres is a good average spacing for most trees and shrubs with one metre for grasses and sedges.

Good timing

Planting in late autumn through to early spring is likely to coincide with better soil moisture. The roots of many plants grow over winter so that a good root system will develop by the summer, helping plants survive dry weather. Avoid planting frost sensitive plants in winter – plant them in spring and water them well over the summer.

Plant the most hardy species first for initial cover (e.g. toe toe, flax, cabbage tree). After one to two years, add frost and wind tender or slower growing species (e.g. tree ferns, rimu, kahikatea) wider apart (about 6m spacing).

Exotic trees can be purchased bare-rooted but native trees are usually bought in bags or root trainers. Plant root trainer seedlings soon after purchase to avoid them drying out.



Native plants in PB3 and PB5 bags ready to be planted

Getting the site ready

Good site preparation and care of your new plants are essential to success.

- ✓ Put up permanent fences to exclude stock before you start. Stock will make short work of tasty seedlings if they get the chance.
- ✓ Clear out all invasive weeds (e.g. gorse and broom) before planting to reduce smothering and competition for young seedlings.
- ✓ Use a herbicide or a spade to clear weeds and grass in circles of about one metre for each plant. Glyphosate herbicides (e.g. Roundup) are good for removing large areas of weeds and the safest sprays to use beside waterways. (See the section on agrichemical use for more details.)
- ✓ Plants can be very sensitive to herbicides so spray well ahead of planting. Use only the recommended rate (not stronger) and spray in an s-shaped pattern to avoid overlap. Use a spade to clear grass and weeds on smaller areas if you have time.
- ✓ Mulch to reduce weed competition. A thick layer of newspaper weighed down with clods, or a one metre square of carpet or non-synthetic underlay split to place around the tree, are effective mulches.
- ✓ Keep organic mulch clear of the stems of native plants as it can damage them.

- ✓ Kill unwanted trees such as poplars and willows by painting stumps with herbicide immediately after cutting. See later sections for more willow removal information.
- ✓ Protect plants from rabbits, hares or possums if necessary. Using larger trees (trunks thicker than a finger) discourages hares. You can buy commercial pest repellents to spray on immediately after planting (e.g. Treepel) or make your own egg paste repellent. Homemade wire rabbit protectors may also be successful. No method is foolproof and you may also need to trap, shoot or poison.
- ✓ Pukeko can nibble and uproot flax and sedge plantings. Using bigger seedlings (40cm high) can help.



Using cardboard as a mulch around a native seedling

Egg Paste Repellant

To deter rabbits and hares from seedlings, mix either:

80g whole egg powder
800 ml water
150 ml of acrylic resin (available from paint shops), or

5 fresh eggs
600 ml of water
150 ml of acrylic resin.

One litre of the egg paste repellant will cover about 50 seedlings.

Mix egg with water, then add resin (if using egg powder mix with a little warm water to form a paste before adding remaining water and resin). Pour through a strainer into the applicator. Spray approximately 20 –30 ml of the mixture over and around each seedling immediately after planting. Thoroughly clean equipment with water following use. Left over mixture can be stored in a deep freezer until needed again.

Getting your plants in the ground

- ✓ An overcast, wet or windless day is best for planting.
- ✓ Handle plants carefully to avoid root damage.
- ✓ Set out plants in their zones at the correct spacing.
- ✓ Dig a good size hole and loosen the soil.
- ✓ Consider placing a slow-release fertiliser tablet in the bottom of the hole to give the plant a good start.
- ✓ Set the plant in the hole and fill three quarters full. Give the plant a very gentle lift to set the roots in a natural position and continue filling with soil, firming as you go. Be careful not to disturb the roots excessively.
- ✓ Water when you plant. In dry areas, you may need to water during summer for the first two to three years.
- ✓ Stake plants to help find them again at weeding time.
- ✓ Mulch to help control weeds and retain moisture.



Local community group planting stream bank

Continuing maintenance

Protect your planted asset!

- ✓ Monitor for animal pest damage and act quickly to control pests.
- ✓ 'Releasing' (removing weeds and grass around your plants) is especially important in the first 2-3 years. See details in the weed and pest section of this booklet.
- ✓ It's helpful to replant if plants die. You can expect 70 to 80 percent survival of good quality seedlings of the right species, planted at the right time and well protected. Most deaths occur in the first few months so replant as soon as you see the gaps to keep weeds out.
- ✓ Other native plants might regenerate in your planting as birds spread seed. Speed this up by planting additional trees and shrubs in the gaps. You can introduce slower growing species under the shelter of the pioneer species – see the examples in the plant lists in this booklet.
- ✓ Native shrubs and trees need little tending once established. Trees for erosion control or timber production need appropriate silviculture – e.g. form pruning to maintain a good central leader in erosion-control trees. Follow with side pruning at five to ten years old to reduce shading underneath.
- ✓ Continue monitoring for problem weeds, animal damage and damage to the fence.

Now you can enjoy watching your planting grow, along with the native birds and insects it will attract!

Rules affecting tree planting

Check the Rules chapter of this booklet for relevant rules including:

- Rules affecting tree planting along waterways
- Rules affecting agrichemical use

Sources of further information

For more information, try:

- Local native plant nurseries and consultants
- "Native Forest Restoration. A Practical Guide for Landowners", 1993. Tim Porteous. Queen Elizabeth II National Trust.
- "Managing waterways on farms: A guide to sustainable water and riparian management in rural New Zealand", (2001). Ministry for the Environment
- Talking to neighbours with successful native restoration projects. They are an excellent source of local knowledge and usually keen to see similar projects around the area.
- Walking around a local restoration project or native plant reserve to see what plants are successful.
- Your local land management consultant or an Otago Regional Council land resource officer or engineering officer for more information about sourcing and planting poplars, willows and native plants for bank stability.

Managing Wetlands, Seeps and Swamps

Wetlands are unique and threatened landscape features. The Otago Regional Council encourages landowners with significant wetlands to consider protecting and restoring these areas as important natural habitats.

Less significant wetlands such as smaller wet areas, seeps and swamps can also play valuable roles in filtering pollutants out of runoff and protecting surface and groundwater.

Funding for wetland protection and enhancement

A key objective of the Regional Plan: Water is to maintain and enhance the values of Otago's remaining wetlands through voluntary conservation. The Regional Council's biodiversity programme can provide financial assistance for landowners wanting to protect wetland areas on their property. Contact the Biodiversity Officer at the Otago Regional Council on 0800 474 082 for more information.



Upper Taieri Scroll Plain Wetlands in the Styx Basin, Maniototo (Photo Neville Peat)

What can managed wetlands achieve?

Think of wet areas as giant filtering sponges - 'the kidneys of the landscape'. Wetland plants slow water flow from the land and absorb water into organic wetland soils in times of flood. In summer, stored water is released slowly to maintain water flows, providing better habitat for stream life.

Managing wet areas, seeps and swamps on your farm can:

- ▶ Improve water quality by filtering sediment, faecal bacteria and phosphorus from runoff
- ▶ Improve water quality by removing soluble nitrogen from runoff and re-surfacing groundwater – in some soils managed wetlands are the most effective solution to reducing the amount of nitrogen reaching waterways
- ▶ Provide habitat for fish, birds and insects, improving local biodiversity
- ▶ Reduce stock losses from bogging and improve stock management
- ▶ Help reduce flood peaks and maintain summer water flows.

Should I drain wet areas in my paddock?

Wetlands with natural values should never be drained but what should you do with wet areas and seeps in your grassed paddocks?

The capital cost of draining wet areas might be cheaper than buying more land but you may require a resource consent, there's a risk that the drained area will remain wet, and you'll have ongoing drain maintenance. It can be more profitable to concentrate on better land instead, and leave wetland filters intact. Fencing out animals can also save money in animal health and stock management.

Excluding stock temporarily from wet areas

If some wet areas are too difficult or inconvenient to fence permanently, you can help water quality with temporary electric fencing in the wetter months. Fencing before winter grazing will keep stock from getting bogged and reduce the polluted runoff. Wet areas often pug quickly and have limited feed value anyway – it could be better to save them for summer grazing when feed is short.



Simple fence excludes stock from a seep

Managing your natural filters

Once nitrogen enters groundwater, it can only be treated where the ground water reappears at the surface, e.g. springs, wetlands and seeps. Keeping these wet areas with their grasses and rushes is essential if you want to remove nitrogen from emerging groundwater. If there is plenty of suitable organic matter, low oxygen levels, and reasonable water retention time, more than 90 percent of nitrogen can be removed.

For wet areas to be most effective as filters they:

- ▶ must remain wet for all or most of the year.
- ▶ must be fenced off from stock. Most sedges, rushes and flax are palatable to stock so they need to be protected. Cattle trampling will also reduce the ability of wet areas to absorb water.
- ▶ may need some planting. Native sedges, raupo, rushes and flax grow well, and are easy and cheap to purchase. They can be divided when big, and the sections planted out. Trees can be counter-productive in or near wetlands as they dry the soil and shade smaller plants.

If you really want to make good use of wet areas and seeps to improve water quality on your farm, you can use them to filter runoff in specific areas. For example:

- ✓ Direct tile and mole drains into wet areas and seeps before they flow into streams,
- ✓ Divert race and track runoff into wet areas and seeps but take care not to smother the area with sediment.
- ✗ Avoid diverting runoff into wetlands with significant natural values.

Rules affecting wetlands

Check the Rules chapter of this booklet for relevant rules including:

- ▶ Rules affecting wetlands

Sources of further information

- ▶ Otago Regional Council Biodiversity Officer Phone 0800 474 082
- ▶ Queen Elizabeth II National Trust
Contact the head office for details of local representatives at P.O. Box 3341 Wellington, freephone 0800 732 878 or look on their website at www.nationaltrust.org.nz
- ▶ Your local Department of Conservation office.



Wetland in South Otago

In-Stream Works and Willow Removal

In-stream works may disturb or alter the streambed, causing permanent or temporary changes to its natural state. Works include construction of bridges, culverts, ford crossings, stabilisation works, waterway clearing or removal of rock and gravel. These works often require heavy machinery to work within the water itself or along the riparian margin adjacent to the waterway.

The potential impacts of in-stream works include:

- ▶ disruption to stream habitat and reduced stream life
- ▶ disruption to fish passage and spawning sites
- ▶ damage to riparian vegetation
- ▶ fish killed and the loss of other aquatic life through contaminants in water.



Care is required when undertaking in-stream works

Avoiding negative effects on the waterway

- ✓ Plan ahead and consult with interested parties. Minimise damage by thinking before you act.
- ✓ Identify the values that apply to the particular section of waterway.
- ✓ Use the most appropriate machinery for the job and experienced operators.
- ✓ Only disturb the area that is absolutely necessary to do the job.
- ✓ Minimise sediment input by working from the bank rather than in the waterway.
- ✓ Ensure machinery is well maintained, and free of oil or fuel leaks before entering the waterway or riparian margin.
- ✗ Do not work in or near water during spawning periods. Damaging fish spawning areas is an offence under the Conservation Act. As a guide, if you are near the coast, avoid disrupting the main whitebait spawning period from February to May. Giant kokopu and banded kokopu spawn between April and July in lowland waterways and drains in Otago. In inland areas avoid disturbing waterways between September and November when non-migratory galaxiids spawn. Check with your local Fish and Game office for details on when trout spawn.
- ✓ Allow for replanting where necessary.
- ✗ Do not release concrete or wash water into the waterway as concrete waste is toxic to fish.
- ✓ Make suitable provision for diversion of main water flow away from construction zones during construction period.
- ✗ Avoid working in water with heavy machinery during times of low flows.

Removing willows

Willows are very useful along many rivers and streams but need to be managed to avoid blockages, debris, ponding or re-routing of the waterway and erosion.

The potential impacts of willow removal from within the riparian margin include:

- ▶ effects on stream life and water quality from debris in the water body
- ▶ increase in stream temperature from reduced shading
- ▶ damage to other riparian vegetation
- ▶ loss of aquatic and wildlife habitat resulting in reduced stream life
- ▶ increase in bank erosion and bank collapse.

If you want to remove problem willows, consider the following guidelines:

✓ Plan the operation and talk with other interested parties.

✓ Check the requirements for resource consents and obtain these where necessary.

✓ Think about the effects of removal on other stream values, such as water temperature and shade for fish, and seek advice on how to provide for these values once willows are removed – e.g. planting other trees to provide shade.

✓ Use experienced fellers and appropriate equipment – for example, a digger might be better than a dozer because it will disturb the site less.

✓ Where willows provide habitat and bank stabilisation, consider management options other than removal or removing the willows selectively and replanting as you go.

✓ Remove all felled trees and branches from the water and banks. Debris left in the floodway can be washed downstream and grow or cause problems for others.

✓ Check the streams and banks after a flood for blockages or channel changes caused by vegetative debris and remove these where necessary.

✓ When using chemicals to poison willow stumps, make sure you don't release any chemicals into the waterway.

Rules affecting in-stream works and willow removal

Check the Rules chapter of this booklet for relevant rules including:

- ▶ Rules affecting in-stream works and willow clearance
- ▶ Rules affecting agricultural use
- ▶ Rules affecting weeds and pests
- ▶ Rules affecting drain management, floodbanks and floodways

Sources of further information

For more information, contact the Otago Regional Council engineering section.

Stream Crossings

If stock and vehicles regularly cross through waterways, it's time to consider alternatives. Regular crossings by milking herds have been highlighted as a major source of rural water pollution but beef, sheep and deer crossings also have significant impacts on water quality.

Studies show the water quality effects of stock directly depositing waste into waterways are equal to, if not greater than those caused by runoff. One study found that a 246 cow herd deposited 37 kg of faecal matter during two crossings of a stream and concluded that cows are 50 times more likely to deposit their waste in a stream than on a race.

Generally, bacteria and sediment levels downstream of stock crossings significantly exceed water quality guidelines, posing health risks to swimmers and to stock drinking the stream water.

Looking at the options

The best crossing options are culverts and bridges.

Culverts are a good cheap option for streams that don't carry too much sediment and don't flood too high. They need to be chosen carefully and installed well to avoid causing erosion and restricting fish movements.

Bridges generally have less impact on stream banks, streambeds and water flow than culverts.

Stock crossings are good for business

Good stream crossings will benefit your farm business by:

- making travel times faster for you and your stock
- improving stock health by reducing stress, lameness and liver fluke
- providing easier access when streams are running high
- allowing new opportunities for farm management
- improving the capital value of your farm
- avoiding exposure to prosecution under the Regional Plan: Water rule 13.5.1.8.

Good stream crossings also benefit the stream environment by:

- preventing stock damage to the stream bed,
- protecting stream habitat for fish and insects,
- reducing sediment and bacteria entering the stream.

Getting culverts right

Correct size and installation will generally save money in the long term by avoiding failure and replacement, and resulting erosion and damage to the stream.

If you build, replace or upgrade a culvert, consider these good management practices:

- ✓ Bigger culverts are generally better if you are concerned about flooding, erosion from over-topping or if high downstream water levels restrict water flow.
- ✓ Make the culvert as wide as, or wider than, the average width of the stream. This will help avoid bypassing or blowouts in floods.
- ✓ Position the culvert so that its gradient and alignment match the stream.
- ✓ Set the floor of the culvert below the stream bed level to avoid vertical drops at the downstream end. A waterfall increases the chance of erosion and also means fish (including trout, whitebait, eels and native fish) can't swim upstream past it.
- ✓ If an existing culvert has such a drop, consider building a simple rock ramp for fish. Use large rocks to form a zigzag staircase from the streambed up to the

downstream outlet of the culvert. This will slow water flow, form small pockets for fish to rest, and reduce the energy of the water coming out of the culvert but shouldn't cause water to back up during floods.

- ✓ Use armouring materials such as rocks around the culvert and especially below the outlet to reduce erosion.
- ✓ Check the manufacturer's recommendations about the depth of fill to put over your pipe to make sure it can withstand loads.
- ✓ Consider building a spillway for extreme floods. A spillway is an area to the side of a culvert where water can flow if the culvert overtops. It should be wide and level across the path of the flow and grassed to prevent scouring. Talk to the Otago Regional Council or an agricultural engineer for design advice.
- ✓ Allow natural streambed material to settle on the culvert floor along its length so that it's easier for fish to swim through.
- ✓ Regular maintenance keeps culverts working well. Make regular checks for debris build-up, especially after heavy rain and flooding.



Poorly designed culvert
(not level with bed, no fish access)



Well-designed culvert
(level with bed, good fish access)

Building sound bridges

If you're thinking about putting in a bridge, use these steps to figure out what you need:

1. When choosing design specifications, think about what you will be using the bridge for – e.g. a wide deck surface for large dairy herds or stronger load bearing for heavy vehicles.
2. Contact your City or District Council and the Otago Regional Council for advice on bridge location, design and consent requirements. Your City or District Council may require:
 - ▶ a land use consent to prepare the site for the bridge
 - ▶ a building consent for the construction of the bridge.
3. Contact your bridge builder and engineer to discuss designs and costs to suit your situation – see www.envirodirect.co.nz for a local consultant. You'll need to take into account:
 - ▶ stream bank material
 - ▶ stream bed profile
 - ▶ flood flows
 - ▶ bridge use
 - ▶ preferred construction materials.

4. Consider these good management practices:

- ✓ Construct your bridge high enough to avoid impeding high stream flows, which would make floods worse and threaten your investment.
- ✓ Minimise your bridge span to keep costs down.
- ✓ Construct raised lips on the deck edges to prevent runoff into the waterway.
- ✓ Channel runoff from the bridge into grassy filter areas.

Standardised plans and materials (e.g. pre-cast abutments and deck slabs) reduce the time and cost of design. Any bridge design must comply with NZ Industry Standards.

5. Remember you'll need a sign stating weight and speed restrictions.

Rules affecting stream crossings

Check the Rules chapter of this booklet for relevant rules including:

- ▶ Rules affecting culverts and bridges
- ▶ Rules affecting in-stream works

Sources of further information

- ▶ Otago Regional Council or your local District or City Council for consent requirements
- ▶ Check out www.envirodirect.co.nz or the Yellow Pages for civil engineers.



Farm bridge

Bringing Back Fish and Waterfowl

Suitable vegetation along riparian margins can provide significant benefits for native freshwater fish, sports fish and waterfowl. Native fish, in particular, have been severely affected by clearance of native forests, drainage of wetlands and land development for agriculture, forestry and urban areas.

What do native fish need?

Of the 30 plus species of native freshwater fish in New Zealand, about 20 are found in Otago but many are threatened by loss of habitat.



Non-migratory galaxiids

Fish species	Habitat
Eels (long-finned and short-finned)	Found in most waterways in Otago. Adults hide beneath logs and overhanging banks. Feed in riparian areas during over-bank floods.
Giant kokopu	Found in coastal wetlands, swampy creeks, forest streams and some lowland lakes. Need plenty of cover from logs, tree roots, overhanging banks, flax bushes and raupo – places where they can hide during the day
Koaro	One of the fish caught as whitebait. Found in forest streams, tussock-clad high country lakes.
Banded kokopu	Found mainly in coastal areas. Also makes up whitebait catch.
Inanga	Found in lower and tidal reaches of most rivers and streams. Makes up bulk of whitebait catch. Spawn in long grass beside estuarine areas and up into those lower reaches of rivers where salt water extends. Severely affected by barriers to upstream migration, and lack of riparian habitat in spawning areas.
Otago galaxiids	Five recognised types of Otago galaxiids. Prefer cover under riverbanks or in the substrate and in the faster-flowing parts of rivers and streams.
Lamprey	Probably spawn in small rocky bush streams.

If you want to provide good habitat for native fish, consider these management practices:

- ✓ Plant riverbanks with good groundcover as well as overhead shade.
- ✓ Keep stock out of waterways as much as possible and control stock access to banks.
- ✓ Keep stock off lowland coastal river and stream banks for successful inanga spawning.
- ✓ Minimise wetland drainage, stream clearing and wetland disturbance.

What do sports fish and waterfowl need?

The type, quality, amount and placement of vegetation on riverbanks play vital roles in the quality and abundance of sports fish, waterfowl and angling opportunities.

Sports fish need:

- hiding places
- shelter (overhead and in the stream)
- shade
- cool water
- insect food (which in turn relies on plant litter)
- a mixture of pools and riffles in runs throughout the stream.

Waterfowl need cover and shelter in streamside vegetation to escape from predators and provide nesting sites.

To provide good habitat consider the following good practice guidelines:

- ✓ Provide good cover for fish and waterfowl, including logs, overhanging banks, in-stream weed and bushy riverbank vegetation that hangs low over the water.
- ✓ Plant close to the edge of the bank for bank stability and allow plants to grow out over the water.
- ✓ For fish, focus your cover planting along the deep side of the waterway or on the outside of bends along runs and pools.
- ✓ For waterfowl, plant along pools and in backwaters over deeper water where flow is slow.
- ✓ You don't need to plant cover along fast or ripply water or along beaches or shallow edges.
- ✓ Sedges, flax, and willows make good cover. Ask your Fish and Game officer for additional suitable plant species.

Rules affecting fish and waterfowl

The Otago Regional Council does not have rules for fish and waterfowl. You should check with the Department of Conservation and the Fish and Game Council regarding rules on fishing and hunting.

The Otago Regional Council does have rules that you need to consider if you are going to enhance habitat along a waterway, or undertake in-stream works. Check the Rules chapter of this booklet for relevant rules including:

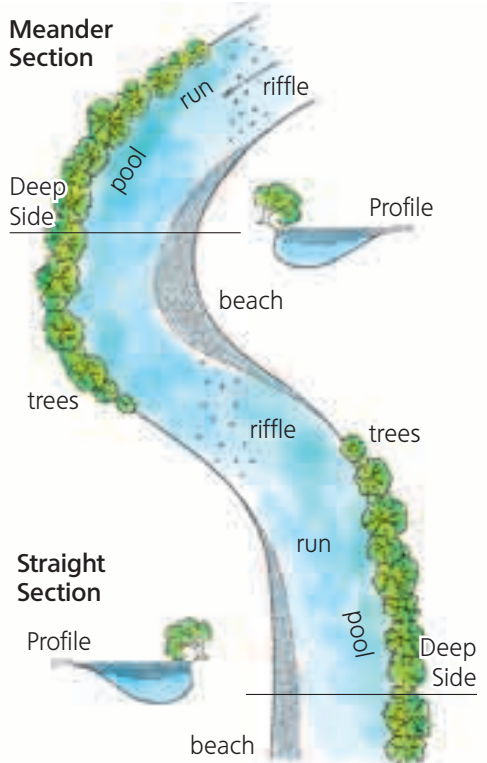
- Rules affecting tree planting along waterways
- Rules affecting in-stream works
- Rules affecting drain management, floodbanks and floodways.

Sources of further information

- Otago Regional Council
- Otago Fish and Game Council
- Department of Conservation

Diagram of habitat on river for sportsfish and waterfowl

Meander Section



Managing Open Drains

Drains can be essential for farm development. They help ensure good grass growth and allow grazing without pasture and soil damage during wetter periods by:

- ▶ Channelling surface runoff (and pollutants) from paddocks
- ▶ Reducing flooding
- ▶ Lowering water tables.

However, it's important to realise that farm drains:

- ▶ Can be important habitats for wetland plants and animals such as eels, trout, whitebait and native water birds. Wetland drainage and removal of streamside vegetation mean that drains are often the only habitat left for native species.
- ▶ Are not isolated waterways. They often flow into natural streams connected to rivers, wetlands, lakes and estuaries. Drains can act as very efficient channels for nutrients and faecal bacteria to travel into larger waterways



A well fenced drain

Water weeds have benefits

A weed is a plant that is growing in the wrong place and is more prolific than we'd like. Weedy plants in drains can block channels, increasing water tables and causing flooding, but they are not automatically a problem and you may not have to spend time and money to remove them. Water plants can provide many benefits, including:

- ▶ They stabilise banks and bed sediments, helping to reduce erosion. Removing them can cause the bank to slump and the drain to silt up.

- ▶ They provide habitat for fish, koura, insects and birds. Bank-side plants shade the water, keeping it cool for sensitive species and providing a habitat for wildlife.
- ▶ They take up dissolved nutrients from the water, helping reduce the nutrients flowing into downstream rivers and lakes where they can cause algal blooms.

Managing drains to reduce maintenance

Drains need to be maintained only if they are becoming blocked with silt or weeds. Prevention is always better than cure, so manage your drains to reduce maintenance.

Some good management practices that can reduce the need for drain maintenance:

- ✓ Fence all drains to reduce silting from stock damage to banks. If permanent fencing isn't practical, use a temporary electric fence to stop stock from crossing.
- ✓ Spray weeds in the drain bed only, not those on the banks. Grassy banks are more stable.
- ✓ Leave an ungrazed grass filter strip beside drains to filter nutrients and sediment from runoff. Make the strip wider at low points where runoff collects.
- ✓ If you cultivate drained paddocks, stop at least two metres away from the drain bank to reduce sediment loss.
- ✓ Plant trees on the north banks to provide shade, reducing weed growth and water temperature.

- ✓ Provide access for cleaning equipment on the south bank by growing lower plants – e.g. native sedge *Carex secta*.
- ✓ Consider putting sediment traps in the slower flowing, wider sections of your drainage network. You can remove sediment from the traps regularly without cleaning the whole drain.
- ✓ Establish drains with a 'V' shaped profile, rather than steep banks, to concentrate flow and help provide a low maintenance weed-free central channel.
- ✓ Allow good access to drains with gateways in drain fences and culverts over side drains, so that they're easy to get to when you do need to clear them.



Long grasses help filter runoff alongside this farm drain

Low impact mechanical drain clearing

Clearing with a digger is a common method that can seem effective but may also:

- Disturb silt and make drain water dirty, affecting spawning and fish feeding, and smothering insect life and valuable water plants
- Change the shape of drains and the way water flows, reducing long-term effectiveness
- Remove insects, fish, eels and crayfish from the drain along with the sediment and weeds
- Distribute weed fragments downstream where they can regrow and cause problems in other waterways.

To reduce the impacts of mechanical drain clearing, consider these good management practices:

X Avoid excavating during peak fish spawning and migration, and bird nesting periods (seek advice from your local Department of Conservation or Fish and Game office for these peak times). If you are near the coast, avoid disrupting the main whitebait spawning period from February to May. Giant kokopu and banded kokopu spawn between April and July in lowland waterways and drains in Otago. In inland areas avoid disturbing drains between September and November when non-migratory galaxiids spawn.

- Inspect the drain with the digger driver beforehand. Identify riffles or areas that shouldn't be disturbed and mark these with aerosol paint or pegs.
- In drains that have fish life (such as eels) have a second person on site who can put the fish back in the drain as you clean them out.

- Use a digger with a weed-rake or a stream-cleaning bucket, to allow water and stream life to escape back into the drain.
- Leave a buffer of weed at the lower end of the drain to trap silt. Clean this area last.
- Spread out drain cleanings away from waterways and wetlands. The concentrated nutrients leaching out of rotting spoil could damage stream life.
- Clean diggers thoroughly to reduce the risk of spreading weed into new areas.
- Seed and replant exposed drain banks soon after clearing.
- When clearing smaller drains, put straw bales or filter fabrics downstream to reduce sediment flowing into other waterways.



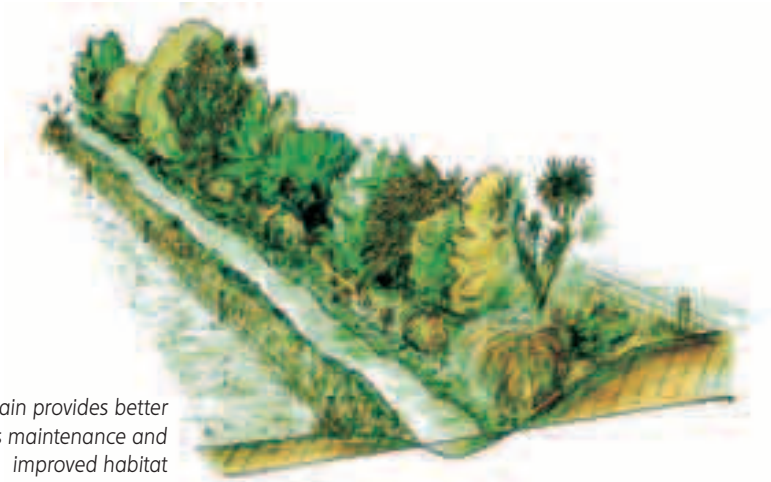
Keep drain banks less than 1:2 to maintain a fast flow in the channel

Creating a V-shaped channel

Steep vertical banks and wide, flat drain bottoms spread out water flow, slowing it and causing sediment build-up. Slower water heats up, encouraging weed and algae growth.

Ideally, the slope of the drain bank should be less than 1:2, that is one vertical unit to two horizontal units of distance. This maintains a faster water flow in the centre of the channel, reducing sediment build-up and weed growth.

Gently sloping edges re-grass quickly, making banks more stable and providing better wildlife habitat. The shallow edges are productive food sources for birds and fish such as young trout and baby eels.



A V-shaped drain provides better water flow, less maintenance and improved habitat

Using sediment traps

If you cannot prevent continuous drain siltation, an in-channel sediment trap can stop sediment moving too far downstream and affecting stream life and other waterways. Sediment traps are relatively wide, short and deep excavations in the drain bed. Talk to the Regional Council for advice about locating and designing sediment traps. You'll need to clear the sediment trap after major storms and at regular intervals.

A rule of thumb to work out an estimate of trap size is:

- 1.5 metres wider than the channel
- length to width ratio between 4:1 and 10:1
- depth of 1.5 metres below the average bed level.

Discuss this with the Council and your local agricultural engineer before you start construction.

Low impact chemical spraying

Herbicides are often used to control drain weeds because spraying is cheaper than mechanical clearing. Spraying is effective but can damage stream life and water quality, for example:

- ▶ Some sprays such as diquat and paraquat are toxic to freshwater insects, even at very low concentrations.
- ▶ Waterweeds provide habitat for freshwater insects and many native fish such as inanga, giant kokopu and shrimp. They also provide food for some birds.

To reduce the impacts of spraying, consider these good management practices:

- ✓ Only spray the centre of the drain where water flow is faster. This leaves the edges undisturbed to provide cover, food and habitat for insects, fish and birds.
- ✓ Spray outside peak native fish spawning and migration periods.
- ✓ Spray ephemeral drains (seasonally wet) when they're dry.
- ✓ Spot-spray targeted weed species rather than blanket spraying.
- ✓ Spray at minimum effective rates more often, rather than at high concentrations and less often. Follow the manufacturers' instructions carefully.
- ✓ Spray weeds when they're smaller to reduce the amount of dead vegetation that stays in the drain and reduce the risk of blockages.
- ✓ Use contact herbicides, which act directly on plant tissue.
- ✓ Contact the Regional Council to check whether you need a resource consent to spray in waterways or drains.
- ✓ Let neighbours know when you're spraying.
- ✓ Clean and dispose of empty chemical containers appropriately.

Low impact hand clearing of drains

Depending on the length and size of drains on your property, hand clearing can be a good low impact option. Methods include:

- ✓ Cutting vegetation on the sides of the channel with a brush-cutter or weed-eater. Where practical, remove cut vegetation so it's not left to rot in the drain and reduce oxygen levels.
- ✓ Removing weeds from the channel with a drain rake, modified scythe or sickle.
- ✓ Walking up a weed-choked drain in waders which can sometimes be enough to create a fast-flowing zone in the centre of the channel.

Rules affecting managing open drains

Check the Rules chapter of this booklet for relevant rules including:

- ▶ Rules affecting agricultural use
- ▶ Rules affecting drain management, floodbanks and floodways in Otago.

Sources of further information

- ▶ Otago Regional Council engineering section

Managing Weeds and Pests

Fenced off and/or planted waterways are often criticised as havens for weeds. You will need to commit time and resources to keeping these areas weed-free.

The most common weeds growing along riparian margins in Otago are gorse, broom, blackberry, old man's beard and crack willow. For detailed fact sheets on how to control these and other weeds, please contact the Otago Regional Council on 0800 474 082.

Managing weeds along fenced waterways

If you are removing weeds from fenced waterways there are several methods you can use including:

- ✓ Spot spraying of weeds with a herbicide safe for use near a waterway. Avoid blanket spraying as this will increase the likelihood of bank erosion, and remove habitat and shade over the stream.
- ✓ Manual weed clearance which can be done on smaller sites or where individual removal of each weed is appropriate. For example, gorse bushes and willows can be cut and the stump painted with herbicide.
- ✓ Carefully managed occasional grazing (see below). This can be a practical way to reduce weeds and keep grass vigorous and dense.

Light grazing can be an acceptable management option where you don't have plants to protect.

- ✓ Keep cattle, deer and intensively grazed stock out at all times – use a temporary electric fence if necessary.
- ✓ Graze with sheep and lighter young stock, as these do less damage to banks and soil.
- ✓ Graze in short bursts, and infrequently, in order to minimise damage and runoff potential.
- ✓ Avoid pugging and runoff - do not graze in winter or wet periods.
- ✓ Do not graze the grass too low, and leave plenty of time for grass to re-grow before wet periods.
- ✓ Exclude unstable banks from grazing.
- ✗ Avoid grazing the riparian margin if the waterway provides important habitat for native or exotic fish.
- ✗ If you are near the coast, avoid grazing within a whitebait spawning area at spawning time (February–May). Whitebait will spawn in the long grass alongside the waterway so it is important to remove stock well before the spawning season to let the grass grow (i.e. January or even earlier).

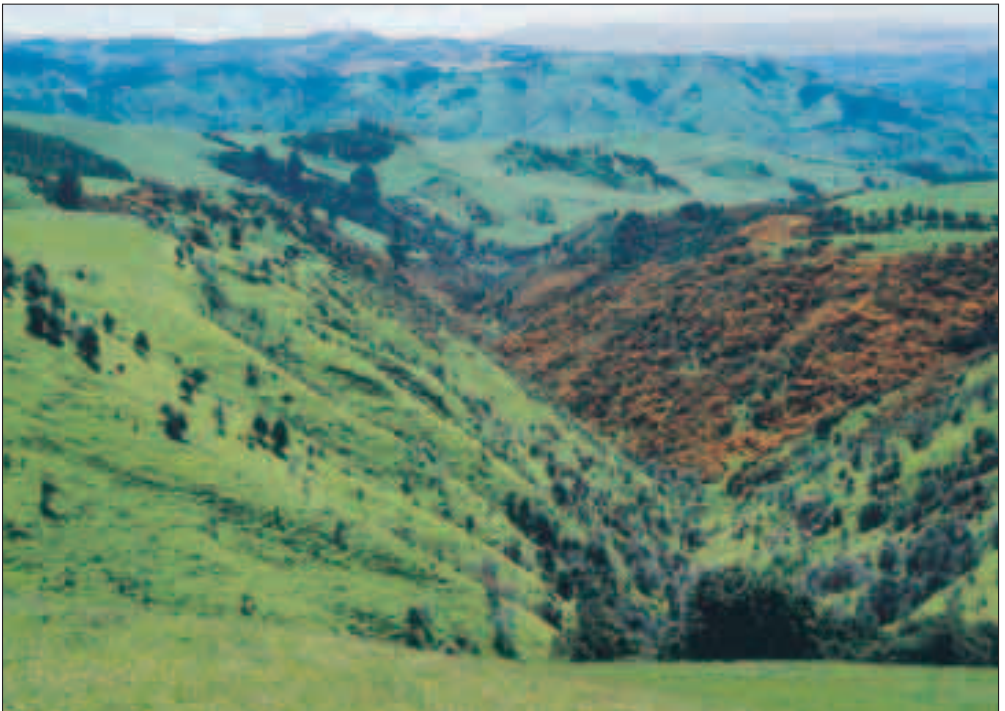


Members of a local estuary care group manually clearing gorse

Managing weeds in planted riparian margins

For weed control along planted riparian margins, where grazing would destroy your native or exotic plants:

- ✓ Remove weeds and grass from around each plant regularly for the first few years. On fertile soils and in warm climates, you may need to release two to four times during the growing season for up to four years. Once seedlings start to form a canopy and shade the ground, weed control will become less important.
- ✓ You can release the plants by grubbing the weeds out or using a herbicide. Native plants can be sensitive to herbicides so be careful. Spray on a calm day and cover the plant you are protecting with a bucket or shield. Hand weed near the base of the native plant.
- ✓ Weeding is often required at busy times so consider paying someone to do it. This might save you the cost of replacing plants the following winter!
- ✓ Mark the position of seedlings with stakes to help you find them for releasing.
- ✓ Avoid blanket spraying with herbicide for releasing, as this will open up gaps for invasive weeds.
- ✓ Plant larger shrubs at close spacing (no more than 1.5 metres) to reduce weed competition and the need for releasing. This may cost more at the outset but save money in the long term by reducing weed control.



Gorse spreads easily along gullies and riparian margins if not controlled

Controlling animal pests

It's important to protect your riparian margins (and your investment!) from animal pests.

- ✓ Make a concentrated effort to reduce pests to manageable levels followed by regular control to keep the populations low, rather than letting pest levels cycle up and down.
- ✓ If you have planted your riparian margin, rabbits need to be controlled until the growing tips of seedlings are above bite height. If hares are a problem then control is needed until plant stem diameter is fairly large, to prevent plants being bitten through or ring-barked.
- ✓ Choose from shooting, fumigant poisons, baits and exclusion fencing. Repellents may deter rabbits and hares. These are available from horticultural suppliers or stock and station agents, or you can make your own.
- ✓ Possum control will be necessary in most areas. This will also reduce the amount of pasture they eat and protect fruit trees and gardens. Bait stations for possums (and rabbits) can provide effective low-input control. Traps are higher maintenance, but once purchased the only cost is labour. Night shooting can also help in narrow bush strips, but is not usually effective in larger bush areas.
- ✓ As your planting matures, it will attract birds and insects. Controlling rats, mice, stoats, ferrets and cats will help keep your planting a healthy habitat for them. Most of these pests can be targeted together with certain poisons, but each requires a different trapping method if poisons aren't used.



Possum caught in a Timms trap

Traps available for hire

Possum, ferret and magpie traps are available for hire from the Otago Regional Council. These traps are safe for urban and rural use. Ring in advance to see if the traps are available – you may need to book a trap if demand is high.

Rules affecting weeds and pests

Check the Rules chapter of this booklet for relevant rules including:

- Rules affecting agricultural use
- Rules affecting weeds and pests.

Sources of further information

- Pest Management Strategy for Otago
- Otago Regional Council Pest fact sheets
- NZ Landcare Trust weed and animal pest database at www.landcare.org.nz

Agrichemical Use near Waterways

Used correctly, agrichemicals (including herbicides, pesticides and animal remedies) can reduce weeds, pests and diseases. Misused agrichemicals can cause considerable harm to the environment.

Particular care is needed when using agrichemicals near waterways. Poor use of agrichemicals can:

- Reduce or kill fish and stream bug life
- Kill off desirable streamside vegetation which provides habitat and erosion control, and
- Degrade water quality.

Ways to avoid impacts

Always plan the use of agrichemicals and take suitable precautions to protect the environment.

- ✓ Follow GROWSAFE® guidelines when using chemicals. This includes reading labels before use and making sure all people who handle agrichemicals have proper training.
- ✓ Always ensure that spray equipment is in good working order to prevent accidental spills or leakages.
- ✓ Calibrate all spray equipment before use. This ensures that the right amount of chemical is applied, reducing the risk of spreading excessive amounts of agrichemicals into the environment.
- ✓ Spot spray targeted weed species rather than blanket spraying large areas to reduce the risk of spray drift or runoff.
- ✓ Spray on a calm day to minimise spray drift.
- ✓ Leave an unsprayed buffer strip along the edge of waterways.
- ✓ Mix or fill spray containers outside the riparian margin.

✓ Dispose of excess tank mix or washing water onto waste ground well away from any waterway. The disposal area must be able to absorb the mix of water without run-off and without risk to wildlife or water quality.

✓ Remove empty containers from the field at the end of each day of operation and store them for return to the manufacturer or your local landfill. Empty containers left in the field often find their way into waterways, increasing the risk of chemicals contaminating the water.

Agrichemical Code of Practice and GROWSAFE® Courses

The best source of information about safe chemical use is the 'Code of Practice for the Management of Agrichemicals NZS8409' published by Standards New Zealand. Copies of this manual are available from any GROWSAFE® training provider.

The New Zealand Agrichemical Education Trust offers GROWSAFE® training programmes throughout New Zealand. For information on who provides these courses in Otago:

- Refer to the national GROWSAFE website www.growsafe.co.nz or
- Look for GROWSAFE® programmes under Training Organisations in the Yellow Pages.

What do I do if a spill occurs?

- ✓ Contain and clean up the spill immediately.
- ✓ Avoid hosing with water – the water may contaminate the waterway, causing harm to the environment and affecting water supplies.
- ✓ Use an absorbent material such as sawdust or dry soil to soak up spilled agrichemicals. Sweep this into a sealable container and contact the Otago Regional Council for advice on disposal (the method will depend on chemical used).
- ✓ If the agrichemical spill is likely to pollute surface or groundwater, soil or air, please notify the Otago Regional Council as soon as possible on the 24-hour pollution hotline 0800 800 033.
- ✓ Remember to wear appropriate safety gear (respirator, overalls, goggles, boots etc) when cleaning up the spill.

Rules affecting agrichemical use

Check the Rules chapter of this booklet for relevant rules including:

- Rules affecting agrichemical use

Sources of further information

Get more information about good agrichemical practices from:

- Otago Regional Council fact sheets
- GROWSAFE® training programmes and course notes.

Otago Regional Council Rules

The Regional Plan: Water for Otago, Regional Plan: Air for Otago, Pest Management Strategy for Otago and Otago Regional Council Bylaw 1999 include rules relating to activities around waterways.

The summary of rules below is intended as a guide only. For details of the rules, please read the relevant plans. For copies of these plans please check the Otago Regional Council website www.orc.govt.nz or phone the Council on 0800 474 082.

Some of the activities you wish to undertake near waterways may require a resource consent, however, many are permitted activities.

A permitted activity means you are allowed to carry out the activity without the need to obtain a resource consent, provided you meet all the conditions associated with the permitted activity.

✓ If you are going to do anything classed as a permitted activity you should check the permitted activity rules in a copy of the relevant plan.

✓ If you think you will need a resource consent, please contact the Otago Regional Council.

✓ Your local City or District Council will also have rules regarding landuse activities beside waterways. This booklet does not cover these rules and you should contact your local City or District Council to check their rules.

Rules affecting agrichemical use

Under the Otago Regional Council Regional Plan: Water there are rules governing pesticide and herbicide use near or over water, including:

- That all agrichemicals must be authorised for use in New Zealand, used for the purposes for which they were designed, and used in accordance with manufacturer's instructions.
- That there should be no direct discharge of pesticides into any waterway, water race or coastal marine area.

If you are controlling weeds on the riparian margin, you need to be aware that it is a **permitted activity to apply herbicide to air or land where it will enter water** providing:

- The herbicide and any additive is authorised for use in or over water,
- Discharge to water is minimised,
- No lawful take of water is adversely affected, and
- Appropriate public notification is carried out. This includes notifying at least one week before spraying, all people either:
 - taking water for domestic supply or
 - holding a resource consent to take water within one km of the application alongside a lake or pond, or one km downstream of the application alongside a drain, water race, stream or river.

The community must be notified through Public Notice if the discharge will occur directly into any lake, river or stream.

If you wish to control weeds within the waterway, you need to be aware that it is a **permitted activity to use any herbicide in or over water** for the control of aquatic weeds providing:

- ▶ The herbicide and any additive are authorised for aquatic use in New Zealand,
- ▶ The herbicide is applied in the form of a gel,
- ▶ The application is carried out by a person who holds a Growsafe Registered Applicator Certificate,
- ▶ Discharge to water is minimised,
- ▶ No lawful take of water is adversely affected, and
- ▶ Appropriate public notification is carried out. This includes notifying at least one week before spraying, all people either:
 - taking water for domestic supply or
 - holding a resource consent to take water within one km of the application alongside a lake or pond, or one km downstream of the application alongside a drain, water race, stream or river.

The community must be notified through Public Notice if the discharge will occur directly into any lake, river or stream.

If aerial spraying of pesticides is undertaken, the pilot must hold a Growsafe Pilots Agrichemical Rating Certificate of Qualification and all reasonable measures must be taken to prevent any discharge of any pesticide within 20 metres of a waterway.

Under the Otago Regional Council's Regional Plan: Air, agrichemical application on land, including production land is a permitted activity when:

- ▶ There is no noxious or dangerous effect at, or beyond, the property boundary resulting from the application,
- ▶ The agrichemical is authorised for use in New Zealand, and
- ▶ Agrichemical discharge is minimised.

If there is public access to the land, you will need to hold a Growsafe certificate and put up required signage.

Except as provided by the above permitted activity rules, any other pesticide use that may enter water requires a resource consent from the Regional Council. If you cannot meet all the permitted activity conditions you will need to apply for a resource consent.



Coastal vegetation

Rules affecting culvert and bridge construction

Under the Regional Plan: Water, constructing a bridge or culvert in or over the bed of a lake, river or stream is a **permitted activity** providing:

- ▶ The catchment upstream is less than 50ha,
- ▶ The bridge or culvert, or its erection or placement, does not cause flooding or erosion of the bank or bed,
- ▶ The site is left tidy following the erection or placement,

If you cannot meet all the permitted activity conditions you will need a resource consent from the Otago Regional Council to undertake stream works or construct a bridge or culvert.



Culvert with rocks to create fish pass on Owhiro Stream, East Taieri

Rules affecting drain management, floodbanks and floodways

The rules regarding drain management cover Council owned or maintained open drains. Privately owned and maintained open drains (i.e. small on-farm drains) are not covered by the rules below.

The Otago Regional Council maintains and/or owns drainage networks in the:

- East and West Taieri
- Tokomairiro
- Lower Clutha District
- West Otago.

Council also maintains flood control schemes on the Clutha River and the Lower Taieri, and other isolated floodbanks throughout the region, as well as the Hilderthorpe floodway in the Waitaki District.

The drains, floodbanks and floodways move water away from farms and protect low-lying areas from floods. The Council Bylaw 1999 covers activities you can carry out on and around these areas to ensure that they function properly.

In summary, the Bylaw states that for any Council owned and/or maintained drains, floodways and floodbanks you will need prior written authority from the Otago Regional Council to:

- Widen, deepen or otherwise alter the drain or floodway or floodbank,
- Obstruct any drain or floodway,
- Remove or interfere with any plant or equipment relating to any drain or floodbank or floodway,
- Connect any pipe, channel or other conduit to any drain,

- Plant any tree or construct any structure (including a fence)
 - in or on the banks of any drain; or
 - within seven metres of the top of the bank or any drain, or
 - in a floodway or on any floodbank or between the floodbank and any waterway, or
 - within seven metres of the landward side of any floodbank,
- Construct any crossing in, over, through or beneath any drain, floodway or floodbank,
- Carry out any excavation in any floodway or floodbank, or between the floodbank and any waterway, or within 20 metres of any floodbank,
- Dump or deposit anything in any drain, on any floodbank or between the floodbank and the waterway or within 20 metres of any floodbank,
- Drive any livestock or vehicle, or take any plant, machinery or equipment through any drain or over any floodbank,
- Discharge any irrigation water to any floodway.

For full details of the Otago Regional Council Bylaw 1999 and maps of the drains managed or owned by the Council, please contact the Otago Regional Council.

Rules affecting fencing along waterways

Fencing along waterways in Otago is a **permitted activity** in most cases (see section on Rules affecting drain management for additional considerations).

If your fence could be deemed a structure under the Water Plan, then when you are fencing within seven metres of the margin of a lake or within seven metres of the top of the bank of any river or stream you must make sure:

- ▶ The fence does not physically prevent or obstruct access for work to avoid or mitigate any natural hazard, and
- ▶ The Otago Regional Council is notified in writing of the location and nature of the structure, at least seven working days before you start putting up the fence.

If you wish to erect a **fence across the bed of a lake, river or stream** you must make sure that:

- ▶ The lake, river or stream is not an outstanding natural feature or landscape,
- ▶ The fence does not impede floods or cause erosion,
- ▶ The fence does not interfere with water navigation,
- ▶ The fence is only fixed to the bed of the lake or river if it is attached to a lawfully established support structure,
- ▶ The fence is maintained in good repair.

If you cannot meet all the permitted activity conditions you will need a **resource consent** from the Otago Regional Council.

Rules affecting in-stream works and willow removal

If you are **undertaking any works in the bed of a lake, river or stream** you should check with the Otago Regional Council before you commence work as you will need either:

- ▶ A resource consent, or
- ▶ To follow a strict set of conditions if the activity is permitted.

This is to ensure that activities in-stream have minimal impact on the waterway or on water quality. Even if the bed is dry, there is a limit to the amount of disturbance that can be carried out as a permitted activity.

The activities you might be carrying out in the bed include fencing, laying pipes, damming a waterway, placing, demolishing or changing structures in the bed, clearing debris, extracting gravel, reclaiming or depositing material, removing willows from the bed, putting in stopbanks or reinstating banks.

If the activity is a permitted activity under the Regional Plan: Water there are conditions relating to such things as keeping floodways clear, controlling erosion and sediment release into water, retaining the natural shape of the waterway and avoiding affecting others downstream. In some cases the Otago Regional Council must be notified before work commences.

Read the Regional Plan: Water for full details of rules affecting in-stream works, their conditions and to check whether you require a resource consent. The User Guide to the Water Plan rules will help you out. Call the Otago Regional Council on 0800 474 082 for more information.

Rules affecting stock access to waterways

Under the Regional Plan: Water for Otago, **stock grazing in or around a waterway** (disturbing the bed of a lake, pond, river or stream where the bed is the space or land which the waters of the river or lake cover at its annual fullest flow without overlapping its banks) is a **permitted activity** providing:

- ▶ No water take is adversely affected, and
- ▶ The stock do not cause or induce conspicuous slumping, pugging or erosion, and
- ▶ Stock do not cause any conspicuous change in the colour or clarity of the water, and
- ▶ No wetland identified in Schedule 9 of the Regional Plan: Water for Otago is adversely affected, and
- ▶ Stock do not significantly disturb indigenous vegetation or the habitat of indigenous fauna, trout or salmon, and
- ▶ No feeding out occurs on the bed of any lake or river.

If your situation does not meet all the conditions listed above, you will need a resource consent from the Otago Regional Council to allow your stock access to waterways.

Rules affecting tree planting along waterways

In the Regional Plan: Water, there are controls on **planting on the bed of a lake, pond, river or stream**.

Where you wish to plant in the bed of a lake, pond, river or stream you must:

- ▶ Not introduce crack willow or grey willow where it does not currently occur, and
- ▶ Not introduce any pest plant listed in the 1996 Pest Plant Management Strategy for the Otago Region, and
- ▶ While planting, keep any release of sediment into the waterway to a minimum, and
- ▶ Ensure planting does not result in discolouration of water, flooding or erosion.

There are some conditions on planting if you intend to plant along a Council owned or maintained drain, floodbank or floodway (see Rules affecting drain management, floodbanks and floodways).

For further details of prohibited plants and conditions on planting in the bed of a lake or river, please read the relevant sections of the Regional Plan: Water for Otago.



Native sedges regrowing along stream channel

Rules affecting weeds and pests

The Pest Management Strategy for Otago covers rules relating to weed and animal pest control. These rules are aimed at ensuring Otago's biosecurity.

Your main obligation as a landholder is to maintain a boundary area free from weeds if your neighbour's property is mainly free of the weed concerned. The width of the boundary control area depends on the species and some weeds need complete control.

Width of weed-free boundary strip

Weed	Width of boundary strip
Ragwort	50m
Gorse	10m
Broom	10m
Nodding thistle	100m

Control of other weeds

Weed	Control needed
Old Man's Beard	Complete control required
Nassella Tussock	Complete control required

There are also some gorse-free and broom-free areas where all gorse and broom must be controlled. Check with the Otago Regional Council to see if your property is in these areas.

The Pest Management Strategy contains rules covering rabbits, hares, chinchillas and rooks. The Pest Management Strategy includes the following:

- Maximum allowable levels, which vary with location, are set for rabbits.
- No person can import or keep a chinchilla unless all breeding age male chinchillas are neutered.

- It is an offence to poison, capture or trap a rook without authorisation. It is also an offence to shoot at a rook, or, in the months September to November (inclusive), to operate a bird-scaring device or discharge a firearm within 500 metres of any tree containing a rook nest, or interfere with any nest.

Rules affecting wetlands

Significant wetlands are **protected** by rules under the Otago Regional Council's Regional Plan: Water. For a list of significant wetlands in Otago, or if you wish to know if your wetland is significant, contact the Otago Regional Council.

Under the Water Plan, no new drainage of significant wetlands can occur without **resource consent**. No activity that requires a resource consent can take place in those areas (which are mapped in the Water Plan) without carefully considering their important values.

You will also need to check your City or District Plan to see if it contains rules relating to activities in significant wetlands.



Wetland in South Otago

Pulling the Threads Together

So what does all this mean for your farm?
It will depend on:

- ▶ Where you live in the Otago Region – soil types and environmental issues will vary.
- ▶ Where your farm is located within your local catchment – management needs differ if you're in the headwaters or on the edge of an estuary down by the sea.
- ▶ What you want to achieve on your farm and downstream from it, and
- ▶ What resources you have – information, advice, plants, money and time.

Most likely a combination of the different approaches in this booklet will meet your needs. Innovation and adaptability are the hallmark of New Zealand farmers, so enjoy using the information in this booklet to create solutions for your special corner of Otago!

Remember, you're not on your own. Farmers throughout Otago and New Zealand are considering how to best manage waterways on farms, to make sure they comply with regional council rules, emerging industry guidelines and overseas consumer demands. Attend field days and talk to your neighbours to learn more and exchange ideas.

If you would like to monitor the condition of waterways on your property and see how your management is making a difference, contact the land resources section of the Otago Regional Council to get a Stream Health Monitoring Assessment Kit.



Making it all happen - Karitane Primary School planting along the banks of the Waikouaiti Estuary

Appendix 1: Useful Contacts and Assistance

Organisation	Contact details	Assistance available
Otago Regional Council	<p>70 Stafford Street Private Bag 1954 Dunedin Freephone 0800 474 082 Phone 03 474 0827 Fax 03 479 0015 Email: info@orc.govt.nz Website: www.orc.govt.nz</p>	<p>Advice on land use practices, waterway management, drain and wetland management</p> <p>Advice on weed and pest control</p> <p>Resource consents for work in or beside a waterway</p> <p>Advice on regional rules</p> <p>Funding for biodiversity projects including wetlands</p>
Territorial local authorities	<p>Central Otago District Council P O Box 122, Alexandra Phone 03 448 6979</p> <p>Clutha District Council P O Box 25, Balclutha. Phone 03 418 1350</p> <p>Dunedin City Council P O Box 5045, Dunedin. Phone 03 477 4000</p> <p>Queenstown Lakes District Council Private Bag 50072 Queenstown. Phone 03 441 0499</p> <p>Waitaki District Council Private Bag 50058, Oamaru Phone 03 434 8060</p>	<p>District or City Plans may control activities on land, including waterbody beds and the surface water. Check your local District or City Plan for rules regarding land use next to waterways.</p>
Fish and Game New Zealand	<p>Otago Region Cnr Hanover & Harrow Sts P O Box 76 Dunedin Phone 03 477 9076 Fax 03 477 0146</p> <p>Central South Island Region 32 Richard Pearse Drive, P O Box 150 Temuka Phone 03 615-8400 Fax 03 615-8401 Email: csi@fishandgame.org.nz Website: www.fishandgame.org.nz</p>	<p>Advice on riparian habitat, where spawning streams are located and how to look after them, and how to look after sports fish and game including trout.</p> <p>On-site visits freely given to provide advice on riparian management or wetland creation. Financial assistance might be provided in special circumstances.</p>

Organisation	Contact details	Assistance available
<p>Department of Conservation</p>	<p>Otago Conservancy Office 77 Stuart Street P O Box 5244 Dunedin Ph 03 477 0677 Fax 03 477 8626 Website: www.doc.govt.nz</p> <p>Check your phone book for details of a local Conservation Department office in your area or contact the Otago area office in Dunedin.</p>	<p>Advice on conservation matters including native fish, native wildlife and their habitats.</p>
<p>Nurseries and consultants</p>	<p>Contact the Otago Regional Council for a list of native plant nurseries or consultants or look in the Yellow Pages.</p>	<p>Advice on propagating, growing, planting and maintaining riparian plants. Advice on weed control.</p>
<p>Queen Elizabeth II National Trust</p>	<p>Contact the head office for details of local representatives. P.O. Box 3341 Wellington Freephone 0508 732 878 Website: www.nationaltrust.org.nz</p>	<p>Advice and assistance to protect areas of significant native habitat.</p>
<p>New Zealand Ecological Restoration Network (NZERN)</p>	<p>Website: www.bush.org.nz</p>	<p>Website contains contact details for environmental groups and agencies working to restore habitat across NZ.</p> <p>Advice on weed control, native plant lists etc.</p>
<p>New Zealand Landcare Trust</p>	<p>NZ Landcare Trust P O Box 39 –141 Christchurch Freephone 0508 526 322 Phone 03 962 9555 Fax 03 962 9557 Email: info@landcare.org.nz Website: www.landcare.org.nz</p>	<p>Support to set up Landcare groups, on-line advice on weed and pest control, and contact details for Landcare groups.</p> <p>Funding available through Transpower Landcare Trust grants</p>

Appendix 2: Native Plant Lists for Otago

The following plant lists give you an idea of the plants that will suit your waterway margin.

Five lists have been created as a guide to reflect the geographic and climatic differences across Otago. Plants that grow on the coast will not necessarily grow in the arid climate of Central Otago.

The plant lists will provide a starting point to identifying suitable native plants for your area. Your own property will contain its own unique set of climatic and soil characteristics that will suit certain plants. Talk to local nurseries, and landowners with revegetation projects to find out what grows best in your location.

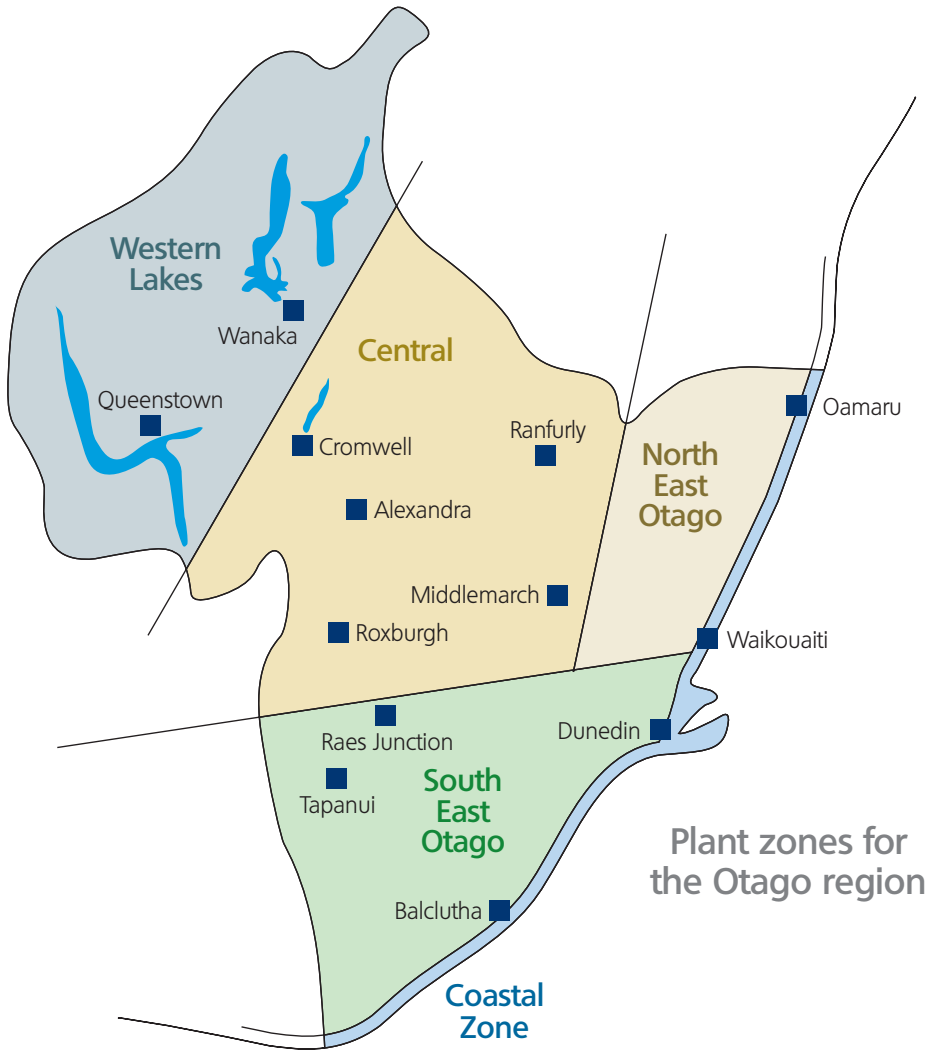
The tables indicate where the plants are most likely to grow on the riparian margin (areas A, B, or C). To refresh your memory on what to plant where, check the Planting the Riparian Margin chapter of this booklet.

The hardiest species that you should plant first are highlighted. It is worth while planting large quantities of these plants to get your planting underway.

Rare species suitable for the riparian margin and once more common in Otago, are indicated with a (R) after their name. If you would like to grow these species, ask your local nursery if they will grow them for you, or talk to the Department of Conservation about how to source the seed and grow them yourself.



Lake Onslow wetlands



Plant zones for the Otago region

Western lakes

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
Aristotelia fruticosa	mountain wineberry		✓
→ Aristotelia serrata	wineberry, makomako	✓	
Carmichaelia petriei	desert broom	✓	
→ Carpodetus serratus	marble leaf, putaputaweta		✓
Coprosma crassifolia		✓	
Coprosma intertexta (R)			✓
Coprosma linariifolia	yellow wood, mikimiki	✓	
→ Coprosma lucida	karamu	✓	
→ Coprosma propinqua	mingimingi	✓	
Coprosma rigida		✓	
→ Coprosma rugosa		✓	
Coprosma sp. aff parviflora		✓	
→ Coprosma virescens		✓	
Coprosma wallii (R)		✓	
→ Cordyline australis	cabbage tree, Ti kouka	✓	
Coriaria sarmentosa	tutu	✓	
Corokia cotoneaster		✓	
Dacrycarpus dacrydioides	white pine, kahikatea	✓	
→ Discaria toumatou	wild Irishman, matagouri	✓	
Dracophyllum longifolium	grass tree, inaka	✓	
Elaeocarpus hookerianus	pokaka		✓
→ Fuchsia excorticata	fuchsia, kotukutuku		✓
→ Griselinia littoralis	broadleaf, papauma	✓	
→ Hebe cupressoides (R)	Cypress hebe	✓	
→ Hebe rakaiensis		✓	
→ Hebe salicifolia	koromiko	✓	
→ Hoheria lyallii	mountain ribbonwood	✓	
→ Kunzea ericoides	kanuka	✓	
→ Leptospermum scoparium	tea tree, manuka	✓	
Lophomyrtus obcordata		✓	
Melicope simplex	poataniwha		✓

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M	✓	
M,H	✓	fast growing, frost tender
M		very hardy
M,H	✓	
M	✓	
M	✓	attractive red-brown foliage
M,H	✓	
M,H	✓	
M	✓	the most widespread, common coprosma
M,H	✓	
M	✓	
M	✓	very cold hardy
M	✓	
M,H	✓	currently only known near Makarora
F,M,H	✓	
M	✓	poisonous to stock
M	✓	
F,M,H	✓	prefers damp ground, wetland margins
M		
M		can be propagation difficulties
M,H	✓	divaricating juvenile foliage
M,H	✓	damper sites preferable, deciduous
M,H	✓	
M		attractive fine whip-cord hebe
M		
M		
M,H		deciduous, white flowers in profusion
M,H		not present in Wakatipu Basin (above Cromwell)
F,M		tolerant of both wet and dry sites
M,H	✓	
M		

Western lakes

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
Melicytus alpinus	porcupine shrub	✓	
→ Melicytus lanceolatus	mahoe wao		✓
→ Melicytus ramiflorus	whiteywood, mahoe		✓
Metrosideros umbellata	southern rata		✓
→ Myrsine australis	mapou	✓	
Myrsine divaricata	weeping matipo	✓	
Neomyrtus pedunculata			✓
Nothofagus fusca	red beech	✓	
Nothofagus solandri var. cliffortioides	mountain beech	✓	
Nothofagus menziesii	silver beech	✓	
Olearia arborescens		✓	
→ Olearia avicenniifolia	akeake	✓	
→ Olearia bullata		✓	
Olearia fimbriata (R)		✓	
→ Olearia fragrantissima (R)	fragrant tree daisy	✓	
→ Olearia hectorii (R)	deciduous tree daisy	✓	
→ Olearia lineata (R)		✓	
→ Olearia odorata	scented tree daisy	✓	
→ Ozothamnus leptophyllus	mountain tauhinu	✓	
Pennantia corymbosa	kaikomako	✓	
→ Pittosporum tenuifolium	kohuhu	✓	
→ Plagianthus regius	lowland ribbonwood, manatu	✓	
Podocarpus totara	totara	✓	
Prumnopitys ferruginea	miro		✓
Prumnopitys taxifolia	black pine, matai	✓	
→ Pseudopanax colensoi var ternatus	three-finger, orihou	✓	
Pseudopanax crassifolius	lancewood	✓	
Pseudopanax ferox (R)	fierce lancewood	✓	
Schefflera digitata	seven-finger, pate		✓
→ Sophora microphylla	kowhai	✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M	✓	
M,H	✓	
M,H	✓	frost tender
M,H	✓	ideal for lakesides and terrace risers
M	✓	slow growing but very hardy
M,H	✓	divaricating shrub with weeping habit
M,H	✓	
H		can grow into very large tree
M,H		the hardiest of all the beeches
M,H		slower growing than other beeches
M		
M		produces abundant conspicuous flowers
F,M		ideal for damp gully bottoms
M,H		
M,H		
F,M,H		deciduous, fast growing and good willow substitute
M,H		
M		
M		
F,M,H	✓	
M,H	✓	a very important successional species in district
F,M,H		large deciduous tree, fast growing
H	✓	slow growing podocarp
H	✓	slow growing podocarp
H	✓	slow growing podocarp
M	✓	
M,H	✓	
M,H	✓	important plant of lakeshore and islands
M	✓	damp shady gullies preferred
M,H	✓	deciduous, a favourite for bellbird and tui

Western lakes

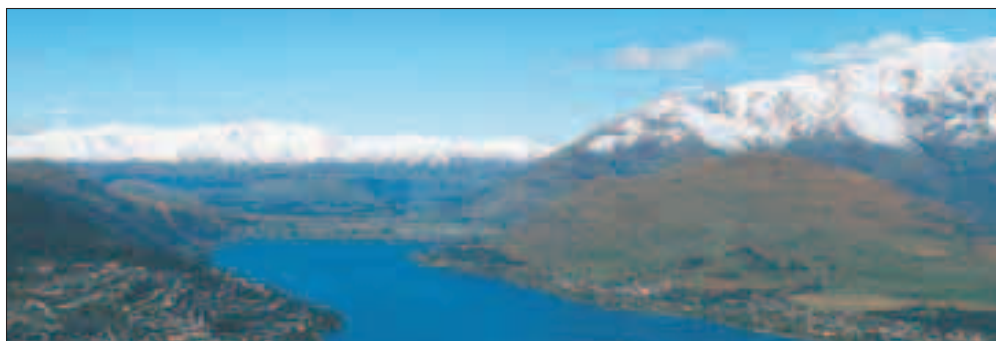
Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Non-woody plants			
Aciphylla glaucescens	speargrass	✓	
Astelia fragrans	bush lily	✓	
Baumea tenax		✓	
→ Carex buchananii	shining sedge	✓	
Carex forsteri			✓
Carex geminata	cutty grass	✓	
Carex lessoniana	rautahi	✓	
→ Carex maorica		✓	
→ Carex petriei		✓	
→ Carex secta	purei	✓	
Carex solandri		✓	
Carex testacea			✓
→ Carex virgata	swamp sedge		
Chionochoa conspicua		✓	
Chionochoa rigida	narrow-leaved snow tussock	✓	
→ Chionochoa rubra	red tussock		
→ Cortaderia richardii	toe toe		
Eleocharis acuta	sharp-spike sedge		
→ Juncus gregiflorus	leafless rush		
→ Phormium cookianum	mountain flax, wharariki		
→ Phormium tenax	harakeke	✓	
Poa cita	silver tussock	✓	
Typha orientalis	bullrush, raupo		

Features of the zone that influence plant selection, establishment and maintenance

- pattern of original vegetation still apparent, at least in the west
- forests dominated by beech
- kanuka absent from Wakatipu basin but dominant around Wanaka
- increasing rainfall along east/west gradient
- immediate lake margins enjoy milder climate
- Severe frosts in Arrowtown basin restrict species selection to the hardest

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M		prefers good drainage
M,H	✓	prefers partial shade
F		
F		erect tussock-like, frost hardy
M,H		
F		
F		
F		
F		
F		large vigorous sedge forming uplifted tufts
F,M,H		tolerates semi-shade
M,H		
F		vigorous green swamp sedge
M,H		large forest edge tussock, prefers damp ground or shade
M		
F,M		attractive, large red-coloured tussock, well adapted to wet soils
F,M		useful in retaining steep banks
F		
F		
F,M	✓	a hardy flax for drier and colder conditions
F,M	✓	most suitable for lowland swamps and wetlands
M		
F		can dominate shallow waterways and ponds



Lake Wakatipu

South East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
→ Aristotelia serrata	wineberry, makomako	✓	
Carpodetus serratus	marble leaf, putaputaweta		✓
Coprosma crassifolia		✓	
Coprosma linariifolia	yellow wood, mikimiki	✓	
Coprosma obconica (R)		✓	
→ Coprosma propinqua	mingimingi	✓	
Coprosma virescens		✓	
Coprosma wallii (R)		✓	
→ Cordyline australis	cabbage tree, Ti kouka	✓	
Cyathea smithii	soft tree fern, katote		✓
Dacrycarpus dacrydioides	white pine, kahikatea		✓
Dicksonia fibrosa	wheki-ponga		✓
Elaeocarpus hookerianus	pokaka		✓
→ Fuchsia excorticata	fuchsia, kotukutuku	✓	
→ Griselinia littoralis	broadleaf, papauma	✓	
→ Hebe salicifolia	koromiko	✓	
→ Hoheria angustifolia	narrow-leaved lacebark	✓	
→ Kunzea ericoides	kanuka	✓	
→ Leptospermum scoparium	tea tree, manuka	✓	
Lophomyrtus obcordata			✓
Melicope simplex	poataniwha		✓
Melicytus flexuosus (R)	leafless mahoe		✓
Melicytus lanceolatus	mahoe wao		✓
→ Melicytus ramiflorus	whitey wood, mahoe		✓
→ Metrosideros umbellata	southern rata		✓
Myrsine australis	mapou	✓	
Myrsine divaricata	weeping matipo	✓	
Neomyrtus pedunculata			✓
→ Nothofagus menziesii	silver beech, tawhai		✓
Olearia avicenniifolia	mountain akeake	✓	
Olearia bullata		✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M,H	✓	fast growing, frost tender
H	✓	
M	✓	
M,H	✓	
M,H	✓	
M	✓	the most widespread, common coprosma
M	✓	
M,H	✓	Catlins area only
F,M,H	✓	
M,H		needs frost protection under a canopy
F,M,H	✓	prefers damp ground, wetland margins
M,H		needs frost protection under a canopy
M,H	✓	divaricating juvenile foliage
M,H	✓	damp sites preferable, deciduous
M,H	✓	
M		
M,H		
M,H		
F,M		tolerant of both wet and dry sites
M,H	✓	
M,H		
M,H	✓	
M,H	✓	
M,H	✓	frost tender
M,H	✓	occurs naturally only south of Taieri Mouth
M	✓	slow growing but very hardy
M,H	✓	divaricating shrub with weeping habit
M,H	✓	
M,H		slower growing than other beeches
M		produces abundant conspicuous flowers
F,M		ideal for damp gully bottoms

South East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
Olearia fimbriata (R)		✓	
Olearia fragrantissima (R)	fragrant tree daisy	✓	
Olearia hectorii (R)	deciduous tree daisy	✓	
Olearia ilicifolia	mountain holly	✓	
Olearia lineata (R)		✓	
Ozothamnus leptophyllus	cottonwood, tauhinu	✓	
Pennantia corymbosa	kaikomako	✓	
Pittosporum eugenioides	lemonwood, tarata		✓
→ Pittosporum tenuifolium	kohuhu	✓	
→ Plagianthus regius	lowland ribbonwood, manatu	✓	
→ Podocarpus totara	totara		✓
Prumnopitys ferruginea	miro		✓
Prumnopitys taxifolia	black pine, matai		✓
Pseudopanax colensoi	three-finger, oriho	✓	
Pseudopanax crassifolius	lancewood	✓	
Pseudopanax ferox (R)	fierce lancewood	✓	
Schefflera digitata	seven-finger, pate		✓
→ Sophora microphylla	kowhai	✓	
Streblus heterophyllus	milk tree, turepo		✓
Teucrium parvifolium (R)	native verbena		✓
Weinmannia racemosa	kamahi		✓

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M,H		
M,H		copers with dry hill slopes
F,M,H		deciduous, fast growing and good willow substitute
M		
M,H		
M		
F,M,H	✓	
M,H		
M,H		
F,M,H		large deciduous tree, fast growing
H	✓	slow growing podocarp
H	✓	slow growing podocarp
H	✓	slow growing podocarp
M	✓	
M	✓	
M	✓	
M	✓	damp shady gullies preferred
M,H	✓	deciduous, a favourite for bellbird and tui
M,H	✓	
M		
H		

South East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Non-woody plants			
<i>Aciphylla glaucescens</i>	speargrass	✓	
<i>Anemanthele lessoniana</i> (R)	wind grass	✓	
<i>Baumea tenax</i>		✓	
<i>Carex geminata</i>	cutty grass	✓	
<i>Carex lessoniana</i>	rautahi	✓	
<i>Carex litorosa</i>	sea sedge	✓	
<i>Carex maorica</i>		✓	
<i>Carex petriei</i>		✓	
<i>Carex secta</i>	purei	✓	
<i>Carex virgata</i>	swamp sedge	✓	
→ <i>Chionochloa rubra</i>	red tussock	✓	
→ <i>Cortaderia richardii</i>	toe toe	✓	
<i>Eleocharis acuta</i>	sharp-spike sedge	✓	
<i>Juncus gregiflorus</i>	leafless rush	✓	
→ <i>Phormium cookianum</i>	mountain flax, wharariki	✓	
→ <i>Phormium tenax</i>	flax, harakeke	✓	
<i>Typha orientalis</i>	bulrush, raupo	✓	

Features of the zone that influence plant selection, establishment and maintenance

- original forest pattern well preserved in Catlins but vegetation patterns very disrupted or absent north of the Clutha River (although good examples of pre-European forest occur near Kaitangata)
- southern rata present naturally only south of Taieri River
- generally abundant and reliable rainfall

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M		prefers good drainage
M		
F		
F		
F		
F		
F		
F		
F		large vigorous sedge forming uplifted tufts
F		
F,M		attractive, large red-coloured tussock, well adapted to wet soils
F,M		useful in retaining steep banks
F		
F		
F,M	✓	a hardy flax for drier and colder conditions
F,M	✓	most suitable for lowland swamps and wetlands
F		can dominate shallow waterways and ponds



Shrubland in the upper catchment of the Catlins River

Coastal

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
→ Coprosma acerosa	sand coprosma	✓	
Coprosma crassifolia		✓	
Coprosma propinqua	mingimingi	✓	
→ Cordyline australis	cabbage tree, Ti kouka	✓	
Fuchsia excorticata	fuchsia, kotukutuku		✓
→ Griselinia littoralis	broadleaf, papauma	✓	
→ Hebe elliptica	shore koromiko	✓	
→ Kunzea ericoides	kanuka	✓	
→ Leptospermum scoparium	manuka	✓	
Lophomyrtus obcordata			✓
Melicytus ramiflorus	whitey wood, mahoe		✓
Metrosideros umbellata	southern rata	✓	
→ Myoporum laetum	ngaio	✓	
Myrsine australis	mapou	✓	
Olearia avicenniifolia	akeake	✓	
Olearia fragrantissima (R)	fragrant tree daisy	✓	
Pennantia corymbosa	kaikomako	✓	
Pittosporum colensoi var. ternatus		✓	
→ Pittosporum tenuifolium	kohuhu	✓	
Plagianthus divaricatus	saltmarsh ribbonwood	✓	
Plagianthus regius	lowland ribbonwood, manatu	✓	
Podocarpus totara	lowland totara		✓
Pseudopanax crassifolius	lancewood	✓	
Pseudopanax ferox (R)	fierce lancewood	✓	
Sophora microphylla	kowhai	✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M	✓	spreading ground cover, very hardy
M	✓	
M	✓	the most widespread, common coprosma
F,M,H	✓	
M,H	✓	damp sites preferable, deciduous
M,H	✓	
M		
M,H		well drained sites only
M,H		tolerant of both wet and dry sites
M,H	✓	
M,H		frost tender
M,H	✓	occurs naturally only south of Taieri Mouth
M,H	✓	
M	✓	slow growing but very hardy
M,H		produces abundant conspicuous flowers
M,H		
F,M,H	✓	
M,H	✓	
M,H		
F		salt water tolerant, ideal for estuary margins etc
F,M,H		large deciduous tree, fast growing
M,H	✓	slow growing podocarp
M,H	✓	
M,H	✓	
M,H	✓	deciduous, a favourite for bellbird and tui

Coastal

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Non-woody plants			
Apodasmia(=Leptocarpus) similis	jointed wire rush, oi oi	✓	
Austrofestuca littoralis (R)	sand tussock	✓	
Bolboschoenus caldwellii	purua grass	✓	
Carex litorosa (R)	sea sedge	✓	
→ Cortaderia richardii	toetoe	✓	
→ Desmoschoenus spiralis	pingao, pikao	✓	
Euphorbia glauca (R)	shore spurge	✓	
Libertia peregrinans (R)	sand iris	✓	
→ Phormium tenax	flax, harakeke	✓	
→ Poa cita	silver tussock	✓	
Schoenoplectus pungens	three-square	✓	

Features of the zone that influence plant selection, establishment and maintenance

- natural vegetation patterns very disrupted or absent
- highly variable zone requiring good matching of species to habitats
- ecologically inappropriate natives have been previously planted e.g. Chatham Island akeake and Cook's Strait groundsel
- exotic plants have often been mistakenly planted as natives e.g. Tasmanian ngaio and pampas grass
- intense weed competition is often present
- severe summer and autumn moisture deficits may exist
- subject to extreme wind, salt spray, storm events, tides and sea level rise
- streams, lakes, lagoons and estuaries are often brackish
- dunes are unstable and often infertile
- rabbits are often serious pests

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
F		estuary margins
F		fore-dunes only
F		
F		estuary margins
F,M		useful in retaining steep banks
F		fore-dunes and rear dunes, excellent sand binder
F		dunes
F,M		dunes and sand flats
F	✓	most suitable for lowland swamps and wetlands
M		
F		suitable for salt marshes and estuary margins



Forest on the coast at Akatore

North East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
<i>Carpodetus serratus</i>	marble leaf, putaputaweta		✓
<i>Coprosma crassifolia</i>		✓	
<i>Coprosma linariifolia</i>	yellow wood, mikimiki		✓
→ <i>Coprosma propinqua</i>	mingimingi	✓	
<i>Coprosma virescens</i>		✓	
<i>Cordyline australis</i>	cabbage tree, Ti kouka	✓	
<i>Coriaria sarmentosa</i>	tutu	✓	
<i>Corokia cotoneaster</i>		✓	
<i>Cyathea dealbata</i>	silver fern, ponga		✓
<i>Dacrycarpus dacrydioides</i>	white pine, kahikatea		✓
<i>Dicksonia squarrosa</i>	rough tree fern, wheki		✓
<i>Discaria toumatou</i>	wild Irishman, matagouri	✓	
<i>Elaeocarpus hookerianus</i>	pokaka		✓
<i>Fuchsia excorticata</i>	fuchsia, kotukutuku		✓
→ <i>Griselinia littoralis</i>	broadleaf, papauma	✓	
→ <i>Hebe salicifolia</i>	koromiko	✓	
→ <i>Hoheria angustifolia</i>	narrow-leaved lacebark	✓	
→ <i>Kunzea ericoides</i>	kanuka	✓	
→ <i>Leptospermum scoparium</i>	tea tree, manuka	✓	
→ <i>Meliclytus ramiflorus</i>	whitey wood, mahoe		✓
<i>Myrsine divaricata</i>	weeping matipo		✓
<i>Olearia avicenniifolia</i>	mountain akeake	✓	
<i>Olearia bullata</i>		✓	
<i>Olearia fimbriata</i> (R)		✓	
<i>Olearia fragrantissima</i> (R)	fragrant tree daisy	✓	
<i>Olearia hectorii</i> (R)	deciduous tree daisy	✓	
<i>Olearia lineata</i> (R)		✓	
<i>Olearia odorata</i>	scented tree daisy	✓	
<i>Ozothamnus leptophyllus</i>	cottonwood, tauhinu	✓	
<i>Pennantia corymbosa</i>	kaikomako	✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M,H	✓	
M	✓	
M,H	✓	
M	✓	the most widespread, common coprosma
M	✓	
F,M,H	✓	
M	✓	poisonous to stock
M,H	✓	
M,H		
F,M,H	✓	
M,H		
M		
M,H	✓	divaricating juvenile foliage
M,H	✓	damp sites preferable, deciduous
M,H	✓	
F,M		
M,H		
M,H		
F,M		tolerant of both wet and dry sites
M,H	✓	frost tender
M,H	✓	divaricating shrub with weeping habit
M		produces abundant conspicuous flowers
F,M		ideal for damp gully bottoms
M,H		
M,H		
F,M,H		deciduous, fast growing and good willow substitute
M,H		
M		
M		
F,M,H	✓	

North East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
→ Pittosporum tenuifolium	kohuhu	✓	
Plagianthus regius	lowland ribbonwood, manatu	✓	
Podocarpus totara	totara		✓
Prumnopitys ferruginea	miro		✓
Prumnopitys taxifolia	black pine, matai		✓
Pseudopanax crassifolius	lancewood	✓	
Solanum laciniatum	poroporo	✓	
Sophora microphylla	kowhai	✓	
Teucrium parvifolium (R)	native verbena		✓
Non-woody plants			
Aciphylla glaucescens	speargrass	✓	
Anemanthele lessoniana (R)	wind grass	✓	
Baumea tenax		✓	
Bolboschoenus caldwellii	purua grass	✓	
Carex buchananii	shining sedge	✓	
Carex geminata	cutty grass	✓	
Carex lessoniana	rautahi	✓	
Carex maorica		✓	
Carex petriei		✓	
Carex secta	purei	✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M,H	✓	
F,M,H		large deciduous tree, fast growing
H	✓	slow growing podocarp
H	✓	slow growing podocarp
H	✓	slow growing podocarp
M,H	✓	
M	✓	fast growing, often arrives of own accord
M,H	✓	deciduous, a favourite for bellbird and tui
M		
M		prefers good drainage
M		
F		
F		
F		
F		
F		
F		
F		
F		
F		large vigorous sedge forming uplifted tufts

North East Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Non-woody plants			
Carex testacea		✓	
Carex virgata	swamp sedge	✓	
Chionochloa rubra	red tussock	✓	
→ Cortaderia richardii	toetoe	✓	
Juncus gregiflorus	leafless rush	✓	
Phormium cookianum	mountain flax, wharariki	✓	
→ Phormium tenax	flax, harakeke	✓	
Schoenoplectus pungens	three-square	✓	
Typha orientalis	bulrush, raupo	✓	

Features of the zone that influence plant selection, establishment and maintenance

- original vegetation patterns very disrupted
- strong seasonal soil moisture deficit gradient towards coast and Waitaki River
- wide variation in climate and soil.

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
F		
F		
F,M		
F,M		useful in retaining steep banks
F		
F,M	✓	a hardy flax for drier and colder conditions
F,M	✓	most suitable for lowland swamps and wetlands
F		
F		can dominate shallow waterways and ponds



Spring fed stream in the Kakanui catchment

Central Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
Aristotelia fruticosa	mountain wineberry	✓	
Carmichaelia compacta (R)	kawarau broom	✓	
Carmichaelia crassicaule (R)	coral broom	✓	
Carmichaelia petriei	desert broom	✓	
Carpodetus serratus	marble leaf, putaputaweta		✓
Coprosma crassifolia		✓	
Coprosma intertexta (R)		✓	
Coprosma linariifolia	yellow wood, mikimiki	✓	
→ Coprosma propinqua	mingimingi	✓	
Coprosma rugosa		✓	
Coprosma virescens		✓	
→ Cordyline australis	cabbage tree, Ti kouka	✓	
Coriaria sarmentosa	tutu	✓	
Corokia cotoneaster		✓	
Dacrycarpus dacrydioides	white pine, kahikatea		✓
Discaria toumatou	wild Irishman, matagouri	✓	
Fuchsia excorticata	fuchsia, kotukutuku		✓
→ Griselinia littoralis	broadleaf, papauma	✓	
Hebe cupressoides (R)	Cypress koromiko	✓	
Hebe salicifolia	koromiko	✓	
Hoheria lyallii	mountain ribbonwood	✓	
→ Kunzea ericoides	kanuka	✓	
→ Leptospermum scoparium	tea tree, manuka	✓	
Olearia avicenniifolia	mountain akeake	✓	
→ Olearia bullata (R)		✓	
Olearia fimbriata (R)		✓	
→ Olearia lineata (R)		✓	
→ Olearia odorata	scented tree daisy	✓	
→ Ozothamnus leptophyllus	cottonwood, tauhinu	✓	
Pennantia corymbosa	kaikomako	✓	
Pimelea aridula	native daphne	✓	

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
M	✓	
M		foliage is very susceptible to animal browse
M		foliage is very susceptible to animal browse
M,H		very hardy
M,H	✓	
M	✓	
M	✓	attractive red-brown foliage
M,H	✓	
M	✓	the most widespread, common coprosma
M	✓	
M	✓	
F,M,H	✓	
M	✓	
M	✓	
F,M,H	✓	prefers damp ground, wetland margins
M		
M,H	✓	damp sites preferable, deciduous
M,H	✓	
M		attractive, fine whip-cord hebe
M		
M,H		deciduous, white flowers in profusion, most suitable for upland wetter
M,H		
F,M		tolerant of both wet and dry sites
M		produces abundant conspicuous flowers
F,M		ideal for damp gully bottoms
M,H		
M,H		
M		
M		
F,M,H	✓	
M		dry tolerant, small rounded bushes with abundant white flowers

Central Otago

Species	Common name(s)	Pioneer (suitable for open, exposed sites)	Secondary (require shelter from existing plants)
Trees and shrubs			
→ Podocarpus hallii	Hall's totara		✓
→ Sophora microphylla	kowhai	✓	
Teucrium parvifolium (R)	native verbena		✓
Non-woody plants			
Baumea tenax		✓	
→ Carex buechananii	shining sedge	✓	
Carex geminata	cutty grass	✓	
Carex lessoniana	rautahi	✓	
Carex maorica		✓	
Carex petriei		✓	
→ Carex secta	purei	✓	
Carex virgata	swamp sedge	✓	
→ Chionochloa rubra	red tussock	✓	
→ Cortaderia richardii	toetoe	✓	
Eleocharis acuta	sharp-spike sedge	✓	
Juncus gregiflorus	leafless rush	✓	
→ Phormium cookianum	mountain flax, wharariki	✓	
→ Phormium tenax	harakeke	✓	
Schoenoplectus pungens	three-square	✓	
Typha orientalis	bulrush, raupo	✓	

Features of the zone that influence plant selection, establishment and maintenance

- lowlands heavily modified so natural vegetation patterns very disrupted or absent
- natural woody colonisers e.g. matagouri can play important nurse role
- low rainfall generally with major soil moisture deficit in summer and autumn
- strong dessicating winds
- severe winter frosts affect the basin floors so spring plantings may be better
- young plants in exposed conditions do need water in their first years so you may need to install an irrigation system.

→ = Very hardy pioneer species suitable for starting a planting project

Suitable sites F=fringe M=midbank H=highbank	Attractive to birds	Notes
H	✓	slow growing podocarp
M,H	✓	deciduous, a favourite for bellbird and tui
M		
F		
F		erect tussock-like, frost hardy
F		
F		
F		
F		large vigorous sedge forming uplifted tufts
F		
F,M		attractive, large red-coloured tussock, well adapted to wet soils
F,M		useful in retaining steep banks
F		
F		
F,M	✓	a hardy flax for drier and colder conditions
F,M	✓	most suitable for lowland swamps and wetlands
F		
F		can dominate shallow waterways and ponds



Tussock lined stream, Central Otago

Reference List

Australian and New Zealand Environment and Conservation Council, and Agriculture and Resource Management Council of Australia and New Zealand, 2000: Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 3 – Primary Industries – Rationale and Background Information.

Collier KJ, Cooper AB, Davies-Colley RJ, Rutherford JC, Smith CM and Williamson RB, 1995: Managing riparian areas: A contribution to protecting New Zealand's rivers and streams. (2 volumes). Department of Conservation, Wellington.

Davies-Colley, RJ, Nagels, JW, Smith, R, Young, R, Phillips, C. 2002: Water quality impact of cows crossing an agricultural stream, the Sherry River, New Zealand. Poster presented at the 6th International Conference on Diffuse Pollution, Amsterdam, September/October 2002.

Davies-Colley RJ, Nagels, JW, Donnison, AM and Muirhead, RW, 2001: Faecal Contamination of Rural Streams – Implications for Water Quality Monitoring and Riparian Management. In Proceedings of NZWWA 2001 Annual Conference.

Davies-Colley RJ and Rutherford JC, 2001: Some Approaches to Measuring and Modelling Riparian Shade. In Proceedings of the International Ecological Engineering Conference, 25-29 November 2001, Lincoln University.

Environment Canterbury, unpublished draft (a): Farm Bridge: Design and Building Process. Environment Canterbury (Resource Care), Christchurch.

Environment Canterbury, unpublished draft (b): Drain and waterway cleaning guidelines – Minimising the impacts. Environment Canterbury (Resource Care), Christchurch.

Environment Canterbury, unpublished report 2001: Notes on water quality analysis of Cust Main Drain stock crossing of Bradshaw dairy herd, October 2001. 3pp. Unpublished report by Adrian Meredith.

Land and Water Resources Australia Research and Development Corporation, 1996: River Management Issue Sheets. LWRRDC, National Riparian Lands Programme, Canberra.

Ministry for the Environment, 2001: Managing Waterways on Farms: A guide to sustainable water and riparian management in rural New Zealand. Ministry for the Environment, Wellington.

New Zealand Dairy Board, 2001. Dairy Industry Environmental and Animal Welfare Policies Pamphlet.

NIWA, 2003. Aquatic weeds: 1. Aquatic weeds in farm waterways – what's the problem? NIWA on No 8 Wired - <http://www.niwa.co.nz/pubs/no8/aquaticweeds1/>. Prepared by John Quinn and John Clayton.

Northland Regional Council. Land Beside Water Factsheet Series. Northland Regional Council, Whangarei.

Otago Regional Council, 1995: Riparian Management Manual. Otago Regional Council, Dunedin.

Otago Regional Council, 2003: Environmental Considerations for Dairy Farming in Otago. Otago Regional Council, Dunedin.

Parkyn SM, Shaw W and Eades P, 2000: Review of information on riparian buffer widths necessary to support sustainable vegetation and meet aquatic functions. NIWA Client Report ARC00262.

Phillips C, Marden M and Rowan D, 2001: Soil stabilising characteristics of native riparian vegetation in New Zealand. Paper presented to NZARM Conference 2001, Hamilton/Landcare Research.

Quinn JM, 1999: Towards a riparian zone classification for the Piako and Waihou River catchments. Environment Waikato Technical Report TR99/16.

Rutherford JC, Davies-Colley RJ, Quinn JM, Stroud MJ and Cooper AB, 1999: Stream Shade – Towards a Restoration Strategy. NIWA and Department of Conservation.

Taranaki Regional Council: Riparian Management Guide. (Pamphlet). Taranaki Regional Council, Stratford.

Tasman District Council, Marlborough District Council and Nelson City Council, 2001: Stream Crossings pamphlet.

Waikato Farm Environment Awards Trust, 2003: A Practical Guide to Low Impact Tracks and Races. Waikato Farm Environment Awards Trust, Hamilton.

Wright, David and Jacobson, Terence, 2000: Managing Streamsides: Stock Control, Fencing and Watering Options. Department of Primary Industries, Water and Environment, Tasmania.

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For resource consent information, and the full wording for permitted activities, contact the consents administration team at the Otago Regional Council.

Contact an Otago Regional Council land resource officer to discuss in more detail any of the information contained within this booklet.

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