

October 2003

How to care for streams in Auckland City

# Watercourse Guidelines



These Guidelines were produced by Metrowater on behalf of Auckland City Council. Assistance with their development was provided by NIWA Ltd and Tonkin and Taylor Ltd.

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# Preface



As a city, Auckland is blessed with many streams. Streams enhance the communities through which they flow and, if properly looked after, are a real asset for our local neighbourhoods. Streams play an important role in our city's stormwater network and are also important natural habitats. The Resource Management Act requires us to manage streams properly to ensure they are safe and carry stormwater without causing flooding or pollution.

Most of the streams in Auckland City are private watercourses. A private watercourse is a stream that passes through private land. It is the responsibility of property owners to look after these streams to prevent flooding, erosion and pollution.

Under normal flow conditions, Auckland streams are narrow. This makes them particularly vulnerable to modifications, such as piping and channelling. Also, urbanisation has had a significant impact on the natural character of our streams, resulting in larger flood volumes and peak flows, and smaller low flows. This often leads to increased bed and bank erosion, reduced water quality and habitat value, and an associated loss of biodiversity.

I believe Auckland is a great place to live, work and play. To keep it that way, we need to work together. One way is to look after our streams. This booklet is provided to help you better understand stream environments and how to take care of them.

Councillor Bill Christian JP  
Chairperson, Auckland City's Works  
Committee

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**Section 1- An introduction to streams** – *discussing urban streams generally and the particular nature of Auckland City's streams. This includes a description of the effects of urbanisation on natural watercourses, and the responsibilities of property owners who have a stream on their land.*

**Section 2 – Stream Management** – *preventative maintenance and other issues surrounding stream management (setting out various stream management issues, starting with preventative maintenance).*

**Section 3 – Monitoring your stream** – *provides methods for monitoring and assessing streams to identify the significance of problems, and the possible causes.*

**Section 4 – Stream Solutions** – *discusses the range of solutions for managing streams, and how to go about choosing the best solution.*

**Section 5 – Simple Maintenance** – *describes simple care and maintenance plans that can help protect your stream and solve small problems.*

**Section 6 – Works in and around streams-** *discusses engineering works that might be appropriate where problems with your stream are more complex.*

**Section 7 – Regulations and Consents** - *outlines the rules and regulations regarding streams, and the legal requirements for people planning work in or alongside streams. This section also presents a brief outline of the consents that may be required, from Auckland City Council or Auckland Regional Council, for works in and around streams.*

**Section 8 – Further information** - *provides a list of key contacts and helpful reference publications.*

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# Introduction

Urban streams have unique characteristics that require particular care and stewardship.

These guidelines and the accompanying stormwater booklet "Rain and the City" (ACC 2003) have been designed to advise on stream management and care, in

combination with integrated stormwater management.

The Auckland City Council and the Auckland Regional Council both have statutory responsibilities regarding integrated stormwater management and the associated management of streams. They also need to take into account the principles of the Treaty of Waitangi, as the use and development of streams and their associated resources can affect Maori culture and traditions.

Both councils have statutory plans that set out their desired stream management objectives and the associated policies and rules that may be applied. Auckland City Council has issued a bylaw specifically relating to stormwater management and has contracted the operation and maintenance of the stormwater network to Metrowater.

The preparation of these guidelines for landowners and occupiers recognises that you are the group most often directly affected by stream processes such as flooding and erosion. These guidelines aim to ensure that when people try to fix stream problems, the difficulties do not appear elsewhere, and the natural values of the stream (visual appearance, habitat and biodiversity) are not damaged.

These guidelines are intended to increase knowledge, raise awareness, and encourage the use of sustainable stream management practices on private watercourses for the benefit of both individual landowners and the wider Auckland community.

*Meola Creek is typical of a large urban Auckland Stream.*



# Using these Guidelines

Auckland City and Metrowater have produced these guidelines as part of our continuing efforts to keep city streams safe and healthy. The guidelines have been developed in consultation with interested parties working on issues related to the management of streams in the urban areas of Auckland City.

The aims of the guidelines are to:

- Provide information for Auckland City property owners whose land has a stream running through or near it.
- Help people and communities choose the right options and tools to deal with their own streams

The guidelines outline a range of stream management solutions - including simple care and maintenance, conceptual engineering works, and maintenance

and planting. They also aim to advise you - the property owner - on finding appropriate professional help when tackling problems with streams on your property and what resource consents and permits may be required for any work you need to undertake.

In particular, it is hoped the guidelines will be used to improve the safety and health of Auckland City's streams by setting out appropriate techniques for managing problems such as flooding, bank instability, erosion, sedimentation, and poor water quality. Appropriate management of these issues will benefit everyone.

The "Rain and the City" booklet (ACC 2003), which has been produced in addition to these guidelines, provides a brief overview

of some key stormwater issues, and refers back to this document for more detailed information.

The information about private watercourses in this booklet is designed to help members of the public comply with the stormwater needs of the Auckland City area.

However the guidelines must not be regarded as full analysis for individual developments. You should always check and confirm the regulatory requirements in the relevant planning documents. These include: The Proposed Auckland City District Plan (Central Area), The Auckland City District Plan (Isthmus), The Auckland City District Plan (Hauraki Gulf Islands) and the Auckland Regional Council Regional Plans.

# Section 1

## An introduction to streams

### What are urban streams?

Streams are a vital part of our urban environment. The bed, banks and water provide important habitats for native flora and fauna (see Appendix A). An urban stream can be a pleasing landscape feature. However, streams are affected by urban development, and changes sometimes cause problems for people living and working nearby.

A *perennial* stream is currently defined in the proposed Auckland Regional Plan: Air, Land and Water (ARC 2001) as a stream which:

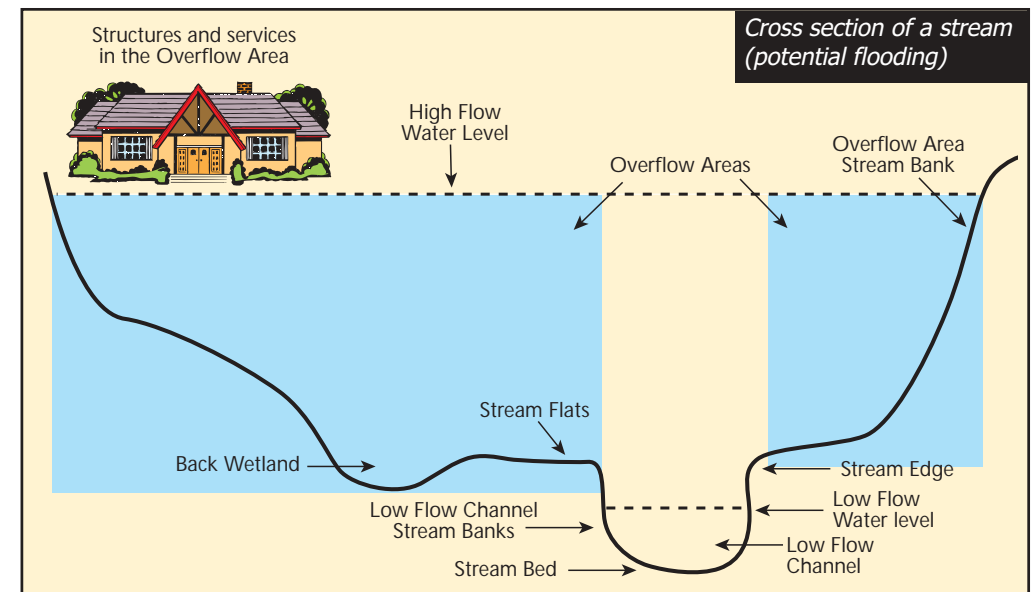
- Appears on the NZMS 260 1:50,000 scale map; and/or
- Has stable pools in late summer; and/or
- Has continuous flow; and/or
- Has any of the following aquatic fauna
  - Native fish (bullies, kokopu, inanga)
  - Crayfish
  - Aquatic snails or shrimp
  - Mayflies, stoneflies or caddis flies

An *ephemeral* stream is defined as any stream that is not perennial.

Streams provide a defined path, or channel, for stormwater runoff and groundwater seepage to drain from the catchment (watershed) to the sea. The channels (or watercourses) generally contain flow within their banks for most of the time, but periodically high stormwater flows will spill over the banks and flood the surrounding land.

Stream bank erosion and landslipping are natural processes, as is erosion and sedimentation of the

Stream flow areas (Whau Creek).



streambed. However, urban development and activity can accelerate the extent and rate of such occurrences. To reduce the risk of damage to property and maintain the character and attractiveness of the stream environment, we need to carefully manage these processes.

### **Auckland City streams**

Auckland City has a variety of stream types and soil types, which reflect the geology of Auckland. The materials forming the streambeds and banks in Auckland City have been broadly grouped into four main units:

- Clay
- Hard volcanic
- Soft volcanic
- Alluvial soils

*Many streams in Auckland City, like this one in Portland Road, are flat.*



Much of the city area, particularly the eastern and western bays, is comprised of siltstones and sandstones. Soils derived from the weathering of these sedimentary rocks are typically clays of low permeability that help stormwater quickly run off the land (stormwater runoff). Sedimentary rock/clay catchments are typically steep - therefore, the streams also have relatively steep gradients, particularly in the upper catchment areas.

Volcanic activity over the past 50,000 years within the Auckland region has produced a series of scoria cones and explosion craters with associated volcanic deposits of ash, scoria/tuff (soft volcanic rock) and basalt (hard volcanic rock). These volcanic deposits cover much of the central and southern city area.

Unlike the clay soils derived from sedimentary rocks, volcanic soils are often highly permeable. This means groundwater can seep in, rather than quickly run off the land as stormwater runoff. Apart from the steep slopes of the scoria cones and tuff rings, the volcanic catchments are typically gently sloping, and the streams in these catchments often originate as spring flows.

The other main geological unit in Auckland is alluvial soils (alluvium).

Valleys were cut into sedimentary rocks by river channels at the time of lower sea levels. These valleys have now been filled in with unconsolidated recent (less than 10,000 years old) sediments such as earth, sand and gravel. As a result, the lower catchment areas tend to be relatively flat with meandering stream channels. Alluvial soils are more easily eroded compared to the other materials.

Generally speaking, streams in Auckland City are relatively short and steep, or they are flat.

During floods, steep streams tend to erode their beds; flat streams tend to erode their banks.

### **The effects of urbanisation**

The effects of urban development impact on the following characteristics of streams and watercourses:

- Stream flow, both flooding and low flows
- Bank erosion and land-slippage
- Water and sediment quality and ecological health

Unless these effects are carefully managed, urban streams will usually deteriorate. Ecologically that means they become less healthy and also less safe for the communities through which they flow - particularly during storms.

To lessen the chances of this happening, an integrated catchment approach - involving land management, stormwater and wastewater – and not focused solely on a small reach of a stream, is often required.

Urbanisation introduces more impermeable surfaces on or over the ground (e.g. pavements, driveways and roofs). Therefore, rainfall runoff flows more quickly to the streams as less is caught in the natural land surface and vegetation. This generally increases the volume and velocity of flood flows in streams and means that flood levels are generally higher in an area that has been urbanised than they were before.

*Accelerated bank erosion and land slippage can be caused by urbanisation (Oakley Creek).*



At the same time, urbanisation almost always reduces the low flows in streams. That's because less water penetrates the ground and therefore less is available to be released as groundwater or spring seepage.

It is possible to reduce flood flows if stormwater runoff is channelled into a piped stormwater system. However, the main result of urbanisation on stream flows is that they become 'flashy' - with larger flood flows and lower day-to-day flows.

Streams can cause different problems depending on what they affect during floods. For instance, the occasional spilling of a stream onto a playing field or reserve is unlikely to cause problems other than some sediment and litter. Streams can cause different problems depending on what they affect during floods. For instance, the occasional spilling of a stream onto a playing field or reserve is unlikely to cause problems other than some sediment and litter. Within a few hours the floodwaters will generally have drained away. But if the spill floods a house, basement, commercial building or road, it could not only damage property but also endanger people's health and safety.

### **Increased stormwater flow from urbanisation**

Auckland City will continue to grow, and Auckland City Council has agreed through the Regional Growth Strategy to manage growth issues such as increased stormwater as far as is practicable. The council is currently undertaking detailed

planning for intensification and development through liveable communities projects.

On-site stormwater management has been introduced in order to manage stormwater quantity and quality, where proposed developments will exceed the city's district plan allowances.

### **Bank Erosion and Land-slippage**

Stream bank erosion and land-slippage are natural processes. However, the higher and more frequent flooding resulting from urbanisation can accelerate this. This in turn can result in increased sediment deposits in the stream channel and increased sediment reaching the harbour.

The effects of accelerated stream bank erosion and land-slippage processes are:

- Faster loss of land adjacent to the stream
- Potential loss of riparian vegetation
- Reduced water quality
- Loss of in-stream bio-diversity
- Sedimentation in flatter portions of streams, estuaries and harbours
- Loss of estuarine ecosystems

A stream bank gradually eroding near a reserve may look unattractive but is not likely to harm people. However, if stream banks erode alongside buildings or roads this may damage property and - more importantly - could endanger lives.

## Water and Sediment Quality and Ecological Health

An altered flow regime will raise the temperature, lower the oxygen in the water and increase pollution (including suspended sediment) in the stream. Barriers may be created which restrict fish passage in the streams.

Erosion and land-slippage, loss of riparian vegetation and discharge of contaminants worsen the situation.

As the water quality decreases so too do the in-stream and stream bank biodiversity, and the general health of the environment. In some cases the in-stream habitat may be completely destroyed.

A healthy stream will support a variety of insects and other animals and fish, which may not be obvious and are often very small. Excellent small field guides, available at libraries and good booksellers, describe New Zealand freshwater life.

Auckland City Council currently has several Wai Care groups monitoring streams around Auckland City. If you want to know more about Wai Care, or wish to create a group for your stream, the Wai Care website [www.waicare.org.nz](http://www.waicare.org.nz) is very useful. Alternatively you can contact Auckland City Council or Auckland Regional Council.

*By providing the necessary resources, the Wai Care programme enables schools and community groups to regularly monitor a stream or water body.*



## Wai Care

Auckland City Council, in conjunction with other councils and the Auckland Regional Council, has created an environmental programme, Wai Care.

Through the Wai Care programme, community groups and schools receive resources to regularly monitor a stream or water body. Wai Care groups can then use this monitoring data to plan practical actions to restore, enhance or protect their water body.

## Section 2

# Stream Management Responsibility for Auckland City streams

Most streams in Auckland City are private watercourses. However, Auckland City Council is responsible for five public watercourses:

- Oakley Creek
- Meola Creek
- Motions Creek
- Remuera Stream
- Newmarket Stream

These streams have been defined as public watercourses so that Auckland City Council can more effectively manage the effects of stormwater and wastewater discharges from the combined main sewers. When the capacity of the main sewers is exceeded by stormwater and wastewater inflows, discharges to these streams occur at designated points.

Streams that pass through private land are generally considered to be private watercourses. Management of these streams and any problems that may arise are, therefore, the responsibility of the property owners through whose land they flow.

Therefore Auckland City Council is responsible for parts of streams passing through Council-owned property, such as parks and road reserves.

All landowners need to maintain and manage their streams so that they can effectively deliver stormwater downstream. This means stream channels need to be kept free of debris and not become overgrown with vegetation. This clearing of streams needs to be balanced with maintaining sufficient riparian vegetation for a stream to remain ecologically healthy.

Stormwater pipes installed during subdivision or other development usually become the responsibility of Auckland City Council. The pipes need to be designed and installed to certain standards before the Council formally assumes ownership. Privately-piped streams - where Auckland City Council has not assumed ownership of the pipes - remain the property of the respective landowners, who are therefore responsible for any associated maintenance.

People living alongside a stream are also responsible for what is piped into the stream from their property. For instance, landowners and occupiers need permits or consents to discharge stormwater, wastewater or other contaminants into a stream. These requirements are discussed

further in Section 8 and the Appendices.

### Natural Hazards

Natural hazards describe natural events or processes - such as flooding, erosion and land-slippage - that impact on property. The identification of natural hazards in Auckland City is the statutory responsibility of both the Auckland City Council and Auckland Regional Council.

However, property owners also must take some responsibility for the management and lessening of the effects of such hazards on their own properties.

### Implications

A landowner needs to take action if a stream is causing a nuisance - such as occasionally flooding the lawn or beginning to erode away stream banks. If you are insured, you also have an obligation to take all reasonable measures to prevent natural disaster damage to the/your property.



*Landowners need to ensure stream channels do not become overgrown with vegetation.*

These guidelines attempt to offer solutions for such problems, with Section 5 discussing appropriate stream management techniques. Many of the solutions are simple and relatively cheap. Where the solution is more complex, advice is given on how to go about getting the right help. In the first instance this will probably involve contacting either Auckland City Council or Auckland Regional Council. Staff from these organisations will be able to offer assistance, or else direct the property owner to other professional advisers.

*If you own a property adjacent to a stream, it is recommended that you have natural disaster insurance cover.*



## Funding Assistance

Auckland City Council may provide financial help where private streams are threatening people or property through flooding or erosion. Under a private watercourse assistance policy, the Council has established grants for private landowners who are suffering from stream-related flooding and erosion on their property.

Details on what assistance may be available under this policy can be obtained from either Auckland City Council or Metrowater. A copy of the decision table used by Council to evaluate the level of any funding that may be provided is included in Appendix B.

## Natural Disaster Insurance

Natural Disaster Insurance cover is available from the Earthquake Commission and private insurance companies.

Under the Earthquake Commission Act 1993, 'residential property' (residential buildings and residential land) is covered to a certain financial and geographic degree for 'natural disaster damage' resulting from 'natural landslip'. Erosion is excluded from the definition of natural landslip, but 'residential land' is covered for damage arising from erosion due to a storm or flood.

The Earthquake Commission does not cover 'residential buildings' for

flood damage.

Flood insurance, and Natural Disaster insurance above that provided by the Earthquake Commission (\$100,000 plus GST) is generally available for residential buildings from private insurers.

All owners of property adjacent to streams should therefore ensure that they have Natural Disaster insurance cover. In the event of damage to, or loss of, property (land and/or buildings) adjacent to streams they should notify their insurance company *and* the Earthquake Commission within 30 days of the damage occurring.

## Issues for Streams

'Stream issues' are overall concerns or problems that must be addressed if stream management practices are to be appropriate and effective.

Flooding, erosion and land-slippage occur naturally - but become problems where they adversely impact on property, pose a risk to people's safety, or impact on natural in-stream values.

In order to prevent the emergence of additional hazards or problems, it makes sense that such areas are defined and new projects restricted wherever possible. In cases where development already exists, appropriate solutions are required to address the hazards and problems



that these natural processes represent.

The main issues for property owners are:

- Flooding
- Bank instability
- Bank erosion
- Sedimentation
- Litter and rubbish in streams
- Streams blocked with vegetation

The worst effects can largely be prevented by appropriate stream maintenance. Careful management of the existing situation may avoid the need for expensive engineering solutions.

As well as the problems created by natural hazards and urban development, issues also arise from:

- General reduction in water quality and stream and riparian habitat
- Loss or degradation of the natural character of streams in the urban environment
- The resulting loss of ecological and cultural values

Effective stream management requires an integrated approach - as flooding, erosion, land-slippage, sedimentation, water quality and ecology are all interrelated. Issues need to be appropriately treated within a catchment-wide context. Activities undertaken in one part of a stream's catchment will most likely have effects elsewhere, so these effects need to be assessed as accurately as possible before any management strategy is finalised.

One particularly important factor when effectively managing a stream is an accurate assessment of any potential or actual flood hazard. The hydrology of urban streams can be particularly complex, so flood hazard assessments and solutions to minimise flood damage require specialist knowledge.

These guidelines present some practical management solutions to the problems discussed above. The balancing of hazard (what is threatened), and risk (how frequently the event occurs) determines what sort of solution is appropriate for a stream, or section of a stream, causing problems.

*Auckland City and Metrowater continually manage impacts on the environment including regularly monitoring water quality.*

## Section 3

## Monitoring

Monitoring your stream is an important part of effective stream management. In order to identify appropriate solutions to problems, it is vital that you can identify what is causing the problem, and how significant it is.



*Landowners can contribute to the effective management of their stream by monitoring flooding and erosion.*

When examining any stream and looking at any solution there are some broad signs to follow. A healthy stream:

- Contains flood flows either in or alongside the streambed (a flood plain is a natural feature)
- Has plants or grasses protecting the stream banks and a diverse in-stream habitat
- Has planting alongside to offer shading and food sources for stream life

### To Monitor Flooding

Monitoring flooding means keeping a record of both normal stream conditions and flood events. Not all rainfall events are the same, and it is important to record the conditions that have occurred before, during and after the event. This can help determine whether the flooding is a recurring event or is related to specific circumstances.

#### 1. Examine the stream:

Walk a little way upstream and downstream, making sure you have permission to enter someone else's property. This can often explain changes such as:

- Development or new sections of piping upstream may mean more

water is coming downstream

- Blockages such as litter or barriers across the flow path downstream can explain water backing up.

#### 2. Take notes:

Write down and record (noting dates):

- How often flooding happens
- How long the water remains ponded
- How far the water extends into an area
- What weather conditions are like
- What rainfall has occurred

#### 3. Observe the stream:

Take photos as a record (noting the date), especially (but not only) when flooding occurs.

### To Monitor Erosion

You need to note changes to stream banks over time so you can help identify any long-term erosion processes. Gradual slumping of sections of stream bank into the streambed may be due to slow undermining of the bank by eroding flows. This may not be as obvious as catastrophic slumping.

#### 1. Mark out stream bank edges:

Put a set of stakes or wooden pegs near the edge of the stream bank

(e.g. 1m from the edge), gradual erosion can be monitored over time.

Measure the distance between the stake or peg and bank edge, and write down any changes over time. This will show whether erosion is continuing and how quickly.

Sometimes there is one-off erosion due to a large storm, then a small adjustment of the banks as the stream stabilises.

#### 2. Take photos:

Over a period of time, photograph areas that seem to be eroding, and date them to compare the changes. Continued movement of streambed material or silting up of the stream could signal future flooding or erosion.

#### 3. Take note of any slumping of stream banks:

If banks have slumped, check to see if the banks are continuing to collapse or whether it was a one-off event.

#### 4. Note any changes to the streambed

Changes may include:

- Silting up of a previously gravel bottom
- The slow shifting of gravel downstream
- Gouging out of the stream bed bottom

## Section 4

## Stream Solutions

A wide range of solutions is available to manage a stream. It may be a simple remedy that you can do yourself - or involve more complex engineered solutions for problems that threaten people's health and safety.

Solutions to stream problems should, where possible, attempt to enhance or create ecological benefits for the stream. This

increases both in-stream values and the amenity of the stream. Widening the stream channel, lining it with concrete and removing all plants may stop a flooding problem - but this approach would severely compromise the health and attractiveness of the stream. A concrete channel is not as aesthetically pleasing as a well-planted and maintained stream.

The key is to find a solution that resolves the problem, while keeping the stream as healthy and natural as practical. The best solutions for stream flooding or erosion are those that strike the ideal balance between maintaining or enhancing natural features and fixing the problem.

When seeking to resolve flooding or erosion the aims are to:

- Provide enough area around the stream for larger storm flows
- Protect stream banks and the streambed from erosion during fast flows
- Provide rough surfaces and planting for stream life
- Make the area attractive.

Although it may not be possible to achieve all these features every time, including as many of them as

possible will create a healthy and attractive stream.

Structural solutions for a stream may solve one problem - but cause others. While structural solutions can create a safer environment, they will usually destroy stream life and result in a less attractive stream environment. They are also generally more expensive than planting and maintenance.

Conversely, natural solutions may not always completely resolve a flooding or erosion problem. When people's health and safety is seriously threatened, the natural features of a stream may need to be modified.

The balance between preventing both flooding and erosion can be difficult to achieve. The wrong works in and around a stream can easily turn a flooding problem into an erosion problem and vice-versa. Streams change naturally over time, so trying to fix the result of a large one-off storm or doing works when a stream is already adjusting to changed conditions can cause problems in the future. It is very important to choose any solutions with caution, and watch the results carefully.

*The use of appropriate plants is one option to help protect stream banks from erosion.*



## Section 5

### Simple Maintenance

All streams in urban areas need maintenance from time to time. It's also important for anyone with responsibility for a stream in their backyard or workplace to take care of the stream in order to avoid any future problems. As a landowner or occupier, you can usually manage most maintenance yourself. You should also be able to solve less serious erosion and flooding problems when given the right solutions.

*Removing debris can be enough to prevent frequent overtopping of a stream bank.*

Maintenance of a stream should focus on:

- Regular monitoring and inspection of the stream to observe changes that may be occurring to the bed and banks (as described in Section 4)
- Keeping the waterway clear of obstructions which might have a significant effect on the stream flow
- Removing litter and rubbish from the stream banks and bed
- Watching out for pollution
- Removing plants that might impede flood flows
- Maintaining the correct type and quantity of planting on the stream banks



#### Keeping Streams Clear

Obstructions in a stream will affect a stream's natural flow. This may increase the water velocity and/or lead to increased flood levels. To minimise the effects of erosion and flooding, you need to ensure that the stream channel is kept clear of significant obstructions, but also remember that suitable vegetation is an important feature of a healthy stream.

A stream should not be used to dispose of any waste - unless specifically authorised. Using a stream as a dumping ground for unwanted waste will significantly damage the flora and fauna. A stream may take several years to recover from a dump of waste liquids, solvents or paints.

Litter also causes problems. Old shopping trolleys, tyres and other large items of rubbish are common in Auckland streams. Keeping a stream free of large pieces of debris can often be enough to solve frequent overtopping of a stream bank.

After a big storm, large logs or other debris may lodge in a stream. If you live alongside a stream, you

should remove these new blockages as soon as possible, as they may cause the stream banks to spill over during the next large flow.

Auckland City Council can issue a notice requiring property owners to clear a stream of debris. If the owners do not comply, the council is empowered under the Local Government Act to do the work and charge the property owners for costs incurred.

A certain amount of ground cover on the stream bank and bed is needed to protect the soil from being eroded during storm flows - but weeds or other vegetation can block streams if they get out of control. You can help prevent flooding by making sure that the stream bank vegetation does not encroach into the waterway too far.

Noxious weeds might look pretty near a stream and act as ground cover, but they are harmful to the environment and should be removed. For a list of noxious weeds and the best methods to remove them, contact Auckland Regional Council.

Always keep in mind that the balance between erosion and flooding can sometimes be delicate.



*Removing litter is just one of the ways landowners can help to care for their stream.*

### **Simple Stream Care and Maintenance Checklist**

Below is a list of simple maintenance activities that will help to keep your stream in good condition:

- Monitor and record erosion and flooding regularly (see Section 4)
- Keep streams free of litter and other debris: natural and manmade
- After storm flows, remove any new large pieces of debris in the stream
- If the stream has stream bank planting, care for these plants - they protect the soil on the banks from erosion during storm flows
- Remove excessive woody weed growth if necessary, but take care to leave cover on stream banks and beds.
- Keep overflow pathways clear. If the stream frequently spills onto land alongside the main streambed during heavy rain, it needs to be able to continue to flow downstream. Fences, walls or buildings on this area will trap water, as will too much planting or the wrong type of plants.
- Check for fish, insect or other freshwater life.

## Section 5

# Works In and Around Streams

Works in and around streams are generally carried out to protect property and ensure people's safety against flooding or land stability problems. Typically, works fall into the following categories:

- Flood risk management
- Erosion prevention
- Bank stabilisation
- Sedimentation control

These are discussed below, together with measures to improve water quality and the stream ecosystem.

If you are planning any engineering solutions, remember that a resource consent and/or building permit will probably be required from either Auckland City Council or Auckland Regional Council (or both) for any work within the stream. Refer to Section 8 to see if you need a permit, and how to go about getting the necessary consents.

### 1 Flood Risk Management

Flooding is natural. Most streams have a flood plain (overflow area) that conveys out-of-channel flow during large storms. So long as the floodwaters don't damage buildings or other structures or services, the temporary high flows will not usually cause serious problems.

If the flood drains away within a few hours and doesn't cause serious damage, the stream should be monitored as outlined in Section 4.

Where there is some damage, or water is not draining away, some initial remedies can help.

Check water is not backing up because there is a blockage downstream. Blockages may be:

- Streambed blockages such as litter or weeds
- Flow restrictions such as pipes or culverts restricting larger flows
- Flood plain blockages (buildings, fences or plants and trees)
- Culvert blockages of debris.

When flooding is threatening the health and safety of people (e.g. homes, workplaces and services) or systems (e.g. roads, power, or water and sewerage systems), then more significant action is likely to be required to manage the higher level of flood risk.

Before taking any action to change a streambed's size or shape, it's important to monitor the frequency and extent of floods. There is a fine balance between erosion and flooding, and changing the

streambed to solve temporary flooding without monitoring can lead to an erosion problem.

### Conceptual Design Solutions

Removing debris, raising or removing fences or changing planting in the overflow area can help increase the area available for floodwaters to fill without causing serious damage. However, it is important to leave appropriate plants in the low flow channel area to protect the banks from erosion, as well as provide habitat and shelter for stream life.

Plants in the overflow areas that are low-lying or bulky can block flows. Rigid plants, such as bamboo, do not bend to allow floodwaters to flow over them and this can increase the flooding risk. Choosing plants that will lay flat with higher flows, but not wash away - such as grasses, rushes and sedges - or putting in taller species with narrower trunks may help flows to pass freely downstream. Refer to Appendix D for a guide to plant selection.

If left unchecked, ginger can inhibit the flow path of a stream. (Whau Creek).





Retaining walls, like this one in Oakley Creek, can be used to help reduce flooding.

Altering the shape and size of the overflow areas along the stream is usually the key to solving higher-risk flooding problems.

The first option for reducing flood risk is to consider whether simple changes in the existing overflow area will solve the problem. Using this approach, the low flow channel can often be left undisturbed.

If changing the existing overflow areas will not solve the problem, you may have to enlarge the overflow area. If designed carefully, creating a larger overflow area can be done without disturbing the low flow channel and any surrounding plants.

Retaining walls can be used to make a flat, wide area deeper and larger by digging out shallow slopes. But remember that engineering advice and design is needed to ensure retaining walls are structurally safe and that nearby buildings, roads and services are protected.

When designing retaining walls, a wide variety of materials in all shapes and sizes can be used. In appropriate soil conditions with sufficient space, making a slope flatter and planting it can be an option. Where less space is available, large loose rocks or timber may be used to stabilise the toe of the slope. In the most difficult cases, vertical concrete walls may need to be installed. Again, the

more natural the solution, the better. Wherever possible the aim should be to leave the low flow channel in a natural state.

## 2 Erosion Prevention

Erosion is how a stream copes with changes to water flows. The extent of erosion will depend on the frequency of higher flows and the type of bank or streambed material.

*Steeply sloped streams* tend to become deeper, not wider, as they erode. The erosion cuts into the streambed rather than the banks, making the stream deeper. This leads to the toe of the stream bank being undercut and the bank eventually slumping into the stream.

The key to reducing erosion in steep streams is to slow down the flow by making the stream less steep and increasing the roughness of the banks. This uses up some of the energy of the fast flowing water and stops scouring of the banks.

*Flatter streams* become wider, not deeper, as they erode. These streams often have soft soils on their banks, which are easily eroded by faster flows. Eventually, the surrounding unsupported bank material will slump into the streambed.

The key to stopping erosion in flatter streams is to strengthen the stream banks and to slow the water flow

against them. Strengthening options range from supporting the banks with plants, right through to carrying out structural works - such as retaining walls - in more serious cases.

If you are thinking about ways to reduce flow speeds, it is important not to turn an erosion problem into a flooding problem. Slowing water down can cause it to overflow the stream banks as it builds up on its way down the stream channel.

Because of the fine balance between

flooding and erosion, advice from a suitably-qualified engineer is needed. The engineer should be able to calculate how a particular erosion solution will affect water levels during various storm flows, and show how far any overflows may extend into people's properties.

### *Conceptual Design Solutions*

When erosion is slowly eating into adjacent land, but is not threatening people's health and safety or nearby buildings and services, the best way to strengthen the banks of flatter slope streams is the use of appropriate plants. Appendix D describes how to choose the best plants for an area after considering soil types and planting locations.

Flatter slope streams tend to have steep banks, but appropriate planting at the top of these banks can still help strengthen the banks. This low-cost solution leaves the stream in a natural state and protects stream life. It is the best long-term solution in cases where erosion is not immediately threatening people or structures.

Where banks are initially too steep for planting, a solution may be to cut the bank back to make it flatter and then plant it. However, it is essential to get professional engineering advice before cutting back banks.

When erosion is occurring and posing a threat to either people's health and safety or buildings and services, there is probably neither space nor time for plants to grow. In this case, protecting the stream banks with rock or engineered structures will probably be the best option.

*Rocks* can help slow flows and protect stream banks, while providing natural in-stream habitat. Rocks of the right size placed at the toe of a bank can help protect the bank and slow water down by increasing the roughness of the streambed.

In some cases, streams may have a particularly steep reach, where the bed of the stream becomes deeper as it erodes down. This eventually leads to slumping of the banks. Placing rocks at the toe of the stream bank protects the toe, supports the banks above, and creates a rough, sturdy surface. Rocks or gabion block walls (rock filled wire mesh baskets) can shift and adjust as flows change over time. They can also provide natural nooks and crannies for stream life to live in.

Creating steps in a streambed can reduce the water's energy and power. Using rocks or gabion blocks to form low weirs and waterfalls as the water moves downstream can

*The use of appropriate plants on stream banks can be a low cost solution to help strengthen the banks and protect stream life. (Meola Creek).*



reduce erosion potential. Care should be taken to avoid - as far as practicable - the formation of unnatural stream barriers, as this can prevent fish migrating up the stream.

Before choosing the correct size of rock to stabilise the streambed channel, you will need to seek professional engineering advice so that the stream flow's maximum likely velocity and power can be measured. If the flow velocity and power are high, the rocks may need

additional reinforcement with timber or concrete piles to prevent them being washed away. It's also important to provide a filter behind the rock to prevent the underlying soil from being washed out. Often a geotextile or filter cloth is used.

In severe cases, the streambed and banks may need to be lined to prevent erosion, or large energy diffusion devices may need to be installed.

### 3 Bank Stabilisation

Like erosion, slippage of stream banks (where the land moves under gravity) is often a natural process.

#### *Conceptual Design Solutions*

Options for stabilising areas of land-slippage adjacent to streams depend on the major causes of the problem. Appropriate *vegetation* can be very effective in maintaining the stability of land adjacent to streams, while also enhancing the appearance and health of the stream.

If the main cause of the land slippage is removal of the toe support by stream erosion, then reinstatement of the support by means of *rocks or gabion blocks* is likely to be an appropriate solution (as discussed in section 7.2). As well as resisting erosion, the weight of the rock mass provides support to the land behind, i.e.: a gravity retaining wall. However, there are some potential disadvantages:

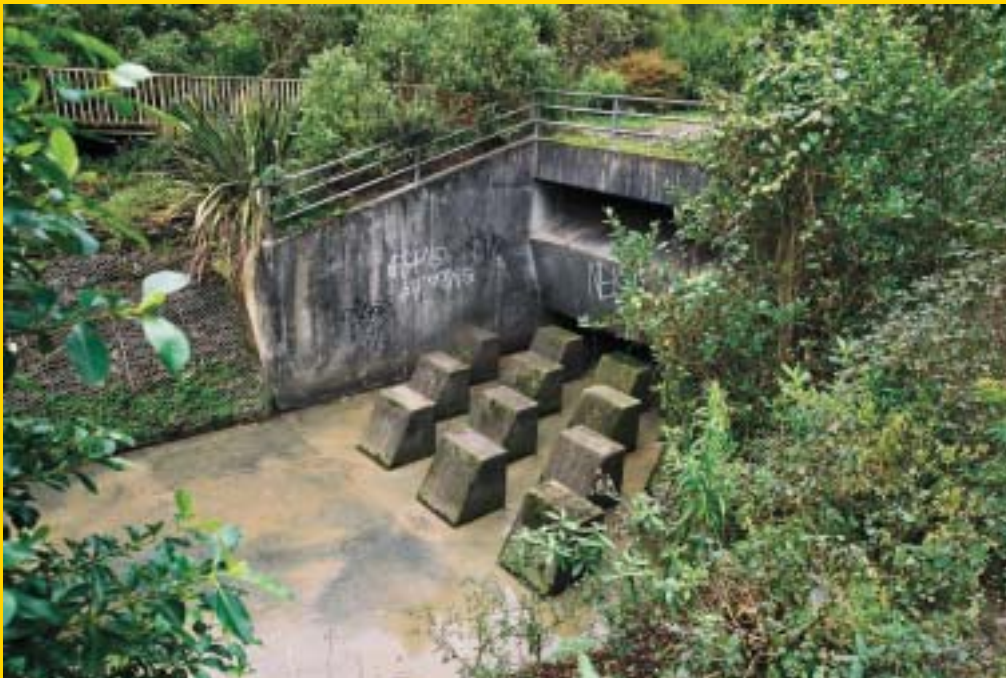
- The land may slip over the top of the rock
- The rock may constrict the water flow by making the stream narrower and/or rougher
- The stream may erode behind the rock, particularly if no filter cloth is provided

If fill (rock, soil, concrete etc) overloading is the main cause, removal of the extra fill is likely to solve the problem. This may mean retaining walls have to be built to support the cutting of the banks associated with the fill removal earthworks.

When saturation of the land above the stream is the main cause, then drainage works such as *buttress or horizontal drains* are likely to be the most appropriate solutions.

Buttress drains (sometimes also called counterfort drains) are trenches excavated down the slope to a depth below the failure surface. These trenches are then backfilled with free-draining material (e.g. gravel or scoria) and fitted with a slotted pipe drain at the bottom. As well as taking water out of the soil, these drains also provide some additional shear resistance into the failing slope. A disadvantage of buttress drains is that they can be difficult to excavate on actively failing slopes. This may mean that drilling is required, which can be expensive.

*In some areas energy diffusion devices may be needed to slow waterflows and help prevent erosion and flooding. (Newmarket Stream)*



Retaining walls may be appropriate where property is at risk. This is a costly option, but it may be the only solution.

In-ground or palisade walls can be very effective in preventing land slippage and improving stability for land up-slope of the wall. These walls consist of poles or piles constructed below the existing ground level, and capped together with a concrete beam. As with conventional aboveground walls,

palisade walls can be designed as a cantilever system or tied back into the ground.

#### 4 Sedimentation Control

Sediment transport in a stream is a natural process.

Streams generally carry some fine sediment most of the time. But during floods, sediment loads are greatest - especially when heavy rainfall occurs in the stream's upper catchment.

Urban development increases impermeable areas, such as pavements and roofs, and causes more rapid runoff. This, together with vegetation removal for construction, can significantly increase sediment loads.

The Auckland Regional Council has produced several publications on how to reduce erosion of land in a catchment and how to reduce the consequential sedimentation of streams (see section 9.2).

Sediment from development sites, principally earthworks, is controlled by Auckland City Council and Auckland Regional Council regulations. Nonetheless, individual owners of properties beside streams should be aware of what is going on upstream - particularly if severe discolouration of the stream occurs, as this could indicate a failure of the upstream erosion or sediment controls.

Sediments generally pass through the stream system and end up in the harbour. Too much sediment reaching our estuaries and harbours can cause problems, as set out in Auckland Regional Council's Technical Publication 69 (refer section 9.2).

Some sediment may not reach the harbour. This material can settle out in the back eddies of the stream, where it can adversely affect in-stream biota by smothering food supplies. It may also settle on a stream's flood plain during periods of high rain. This sediment can contribute to the fertility of the flood plain, but may also be a nuisance if litter is deposited with the sediment.

#### *Conceptual Design Solutions*

Sediment control and any related guidelines are primarily aimed at large, multi-lot land development projects. However, the cumulative effect on water quality from site works on individual properties can be considerable. Soil and any waste earthworking materials (organic and inorganic) that might produce sediment need to be contained or protected from rainfall and flooding, so that they cannot enter the stream.

Mulch spread over bare ground is very effective in reducing soil erosion, and so is grass cover once it becomes established.

*Gabion blocks help prevent land slippage caused by erosion. (Meola Creek).*



Silt fencing may be an appropriate short-term solution to contain sediment runoff until a protective cover can become established.

People often use stream banks as dumping sites for organic (e.g. grass clippings, weeds and branches) and inorganic (tins, car parts etc) waste. This is illegal, and contravenes Auckland City Council's Stormwater Management Bylaw.

*During floods the amount of sediment increases especially when there is heavy rainfall in the stream's upper catchment. (Oakley Creek)*



## Water Quality and Ecosystem Improvements

Streams within urban Auckland will continue to be affected by the urban nature of their catchments and growth. Auckland Regional Council acknowledges this in suggesting an overall management approach for urban streams in the Proposed Auckland Regional Plan: Air, Land and Water.

Opportunities do, however, exist to improve a stream's water quality, the in-stream environment and the *mauri* (life force) of the stream.

These include:

- Controlling the amount and quality of direct and diffuse stormwater discharges that may enter a stream
- Restoration of stream riparian buffer strips
- Stabilisation and protection of stream banks
- Designing new urban areas that preserve wetlands and natural stream channels

As well as maintaining and, where practical, enhancing water quality, management options also exist to improve the health of a stream's natural ecosystems. These include:

- Designing structures to assist fish passage
- Designing structures to provide appropriate habitat
- Improving shade to lower water temperature

- Removing invasive weeds
- Forming rocks and pools

## Seeking Professional Advice

The interaction between stream processes that cause flooding, erosion, and stability problems for adjacent land can be complex. When trying to manage the processes and control the problems they cause, it is important to understand that something done at one location can potentially affect the stream and land up and downstream.

While an affected property owner may be capable of undertaking some of the simpler works outlined above, it will often be wise and, in the long run, cost-effective to seek professional advice.

For the more expensive and costly works, you should seek advice from an appropriately qualified consulting engineer, or other resource management specialist. Any professional advice should include:

- Identification of appropriate engineering or non-engineering solutions
- The design of any necessary works
- The analysis of the effects of these for the stream system and other properties along the bank, both upstream and downstream



- Any requirements for obtaining resource consents - especially for work in or adjacent to a watercourse
- Preparation of the consent application

These professionals can also provide realistic estimates of the costs of any proposed works. As well, they can prepare the subsequent work contract documents and supervise construction.

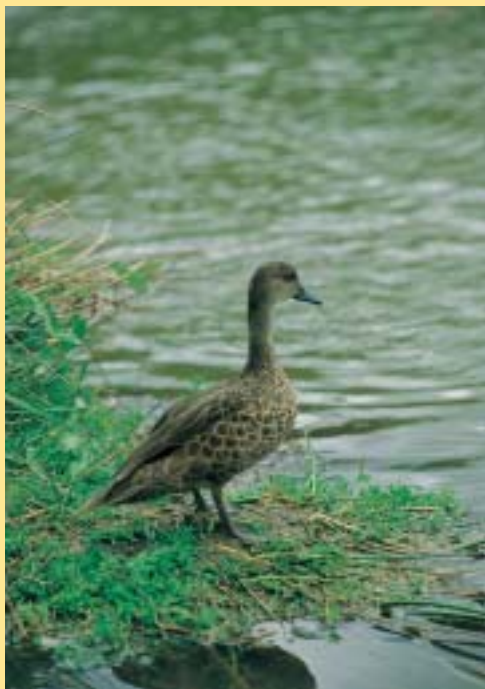
A number of consultants can provide the services required, but first of all you should seek advice from staff at Auckland City Council, Auckland Regional Council or Metrowater. They can help you find the appropriate professional help for your needs.

*Healthy streams are not only aesthetically pleasing but are also better able to support stream life. (Meola Creek)*

## Section 7

## Regulations and Consents

Central and local government legislation sets out what you can and cannot do in and around streams. A property owner must be aware of these rules and regulations, as the penalties for carrying out unauthorised activities can be severe.



The rules are generally contained in the following:

- Resource Management Act 1991
- Building Act 1991
- Auckland City Consolidated Bylaw 1998 – Part 18 Stormwater Management

The Resource Management Act's overall purpose is to promote the sustainable management of natural and physical resources. This act governs all development activities, and the Auckland City Council and Auckland Regional Council administer its requirements in Auckland

The city council has produced a district plan and the regional council has produced several regional plans. These describe how Auckland's natural and physical resources will be managed in a sustainable manner and what resource consents may be required.

The Building Act sets out rules regarding building works, use and safety. Under this Act, the management of building works – including their relation to natural hazards - is the responsibility of Auckland City Council, which issues

building permits for activities which meet regulations.

Auckland City Council also has a stormwater bylaw, which regulates the management of natural stormwater runoff. This minimises the adverse effects of stormwater on people, property and the environment.

Any person or organisation carrying out works or development activities **must** comply with the requirements of all of these regulations.

A more detailed description of the regulations and their requirements is in Appendix C. The process of obtaining a resource consent or a building consent is described below.

### Obtaining a Consent

Simple acts, such as picking up litter in a stream, will not require a resource consent. However, any works in or next to a stream, any discharges into a stream, or building works within a stream, will probably require various consents or permits under the Acts and bylaws outlined above. Sometimes, consents or permits may be required under (all) the legislation listed.

Remember that if you carry out any activity without a consent that requires one, you face severe penalties. You may be fined or ordered to remove the work done. If you have any doubt about whether a consent is required, contact Auckland City Council and Auckland Regional Council and talk to their staff about your proposal.

To obtain a consent, an application must be made to the appropriate authority (Auckland City Council or Auckland Regional Council). Both organisations can provide standard application forms and help on how to complete them. Information is also available on their websites. As part of the consent process, it will generally be necessary to prepare an Assessment of Environmental Effects report (AEE) on the proposed activity.

There is also a requirement to consult parties who could be affected by the proposed activity. This includes neighbours and local representatives of tangata whenua.

**Refer to Appendix C for more details on statutory and legislative requirements.**

## Section 8

## Further Information

Auckland City Council  
Utility Planning Ph 379 2020  
City Environments Ph 379 2020  
Pae Herenga Tangata Ph 379 2021  
(Maori Policy Group)  
[www.aucklandcity.govt.nz](http://www.aucklandcity.govt.nz)

Metrowater  
0800 FOR WATER (0800 492 837)  
[www.metrowater.co.nz](http://www.metrowater.co.nz)

Auckland Regional Council  
Ph 366 2000  
[www.arc.govt.nz](http://www.arc.govt.nz)

Earthquake Commission  
Ph (04) 499 0045  
[www.eqc.govt.nz](http://www.eqc.govt.nz)

### References/Useful Documents

- Auckland City Council, 2001: *Auckland Isthmus Streamside Planting Guide*
- Auckland City Council, 1999: *Auckland City District Plan, Isthmus*
- Auckland City Council, 1997: *Proposed Auckland City District Plan, Central Area*
- Auckland City Council, 1996: *Auckland City District Plan (Hauraki Gulf Islands Section)*
- Auckland Regional Council, 2003: *Stormwater Management Devices: Design Guidelines Manual, Section Edition, Technical Publication No. 10*
- Auckland Regional Council, 2001: *Proposed Auckland Regional Plan: Air, Land and Water*
- Auckland Regional Council, 2001: *Native Forests and Wetlands – A Guide to the Care and Protection of Natural Areas*
- Auckland Regional Council, 2001: *Riparian Zone Management Strategy and Guideline*
- Auckland Regional Council, 2001: *Restoration of Native Forests and Wetlands in the Auckland Region*
- Auckland Regional Council, 2001: *Auckland Regional Plan: Sediment Control*
- Auckland Regional Council, 2000: *Low Impact Design Manual for the Auckland Region, Technical Publication No. 124*
- Auckland Regional Council, 1999: *Guidelines for Stormwater Runoff Modelling in the Auckland Region, Technical Publication No. 108*
- Auckland Regional Council, 1999: *Erosion and Sediment Control, Guidelines for Land Disturbing Activities, Technical Publication No. 90*
- Auckland Regional Council, 1999: *Auckland Regional Policy Statement*
- Auckland Regional Council, 1996: *The Environmental Impacts of Accelerated Erosion and Sedimentation. ARC Environment Division, Technical Publication No. 69*

# Appendix A

## Stream Ecology

Table A1: Auckland Native Fish		General Needs and Habitat
Common and <i>Scientific Names</i>		
Banded Kokopu <i>Galaxid fasciatus</i>	Likes	Pools, water over 15 cm deep and less than 3m wide, some streambed cover (logs, rocks, plants)
	Eats	Insects – aquatic and terrestrial Doesn't need shade
Common bully <i>Gobiomorphus cotidianus</i>	Likes	Still water and pools, water over 10 cm deep, some streambed cover
	Eats	Aquatic insects and crustaceans Doesn't need shade and will tolerate a muddy or silty streambed
Giant Kokopu <i>Galaxid argenteus</i>	Likes	Some water flow, water over 30 cm deep and 0.5m wide, logs or other streambed cover
	Eats	Insects – terrestrial and some aquatic Doesn't need shade. Doesn't like straightened or channelised streams.
Inanga <i>Galaxid maculatus</i>	Likes	Still water and pools, water over 10 cm deep, some streambed cover
	Eats	Aquatic insects and crustaceans Doesn't need shade and will tolerate muddy or silty streambed
Red fin bullies <i>Gobiomorphus huttoni</i>	Likes	Water running over gravel or stones (riffles), water up to 20 cm deep and over 0.5m wide, rocky streambed and banks.
	Eats	Aquatic insects Doesn't need shade
Short fin eel <i>Anguilla australis</i>	Likes	Pools, water over 15 cm deep and less than 3m wide, some streambed cover (logs, rocks, plants)
	Eats	Aquatic insects Doesn't need shade

Each stream provides unique conditions for stream life. This may include fish, plants and algae, insects and their larvae, and shellfish. The types of life found in a stream are mainly affected by water flows, the amount of shade, the nature of the stream bed, and water quality. This interaction is known as the ecology of a stream.

Changes to land use can alter a stream's ecology. Land development often results in:

- Streams being straightened and piped
- The removal of plants from around the stream
- Changes to the quality of the water running through the stream

Few stream plants and animals can tolerate these alterations to their habitat.

The presence of fish in a stream is an important measure of the ecological health of a stream. Because fish are generally at the top of the food chain, they are very dependent on a stream's ecological health. Fish need food and shelter, and so do their food sources. Fish often feed on insects and their larvae. Insects need plants and

rocks to live on and under, and some feed on the algae growing on rocks and plants - or on smaller animals that feed on algae.

Like any natural system, the stream needs to be self-supporting, with the plants and animals all interacting and dependent on diversity to survive.

Six main native fish species may be found in Auckland streams. Some Auckland fish are hardier than others, as indicated in Table A-1. Each fish species is reliant on particular conditions and food. A long stretch of healthy stream in Auckland can be expected to have some fish in it.

# Appendix B

## Private Watercourse Assistance

Auckland City Council Decision Matrix  
(Undertaken by ACC Engineer / Supervisor)

### Decision Matrix A: TYPE OF ASSISTANCE INDICATED

- Please circle the appropriate steps taken
- Complete Matrix B overleaf if funding assistance indicated(City Works Report "Private Watercourse Assistance" meeting of 4 August 1999)

#### 1. Life and Safety

Is human life or safety at risk from flooding or erosion?	<b>YES</b>	Council <b>will</b> assist - to Table B
	<b>NO</b>	Go to 2

#### 2 Habitable Floors

Is a consented habitable floor(s) at risk from flooding	<b>YES</b>	Council <b>will</b> assist - to Table B
	<b>NO</b>	Go to 3

#### 3 Private Property

Is the property at high risk of flooding or serious rapid erosion that could adversely impact consented buildings or existing accessways to the property.	<b>YES</b>	Council <b>may</b> give limited design assistance and/or verbal advice only - now go to 4
	<b>NO</b>	Go to 6

#### 4 Timing

Is it a sudden problem? (as opposed to developing gradually) assistance and/or verbal advice only-	<b>YES</b>	Council <b>may</b> give limited design
	<b>NO</b>	Go to 6

#### 5 Council Services or Property

Are Council services or property under direct threat?	<b>YES</b>	Council <b>may</b> agree to a cost-share
arrangement for remedial work	<b>NO</b>	Go to 6

#### 6 Advisory Service

- 6.1 Provide an advisory service to advise private property owners how to naturalise or stabilise their watercourses, where requested.
- 6.2 Inform residents of their responsibilities with respect to watercourses on their property and their need for regular maintenance.
- 6.3 Piping of open drains or watercourses is to be discouraged but, when approved, the owner will meet the cost and construct the piping in full compliance with the watercourse bylaw, appropriate technical standards, and any other requirements of either the ARC or the relevant catchment management plan.

**Private Watercourse Assistance Matrix  
DECISION TABLE B**

Factors	Weight	Likelihood of Council Responsibility			Total Points	Max Points
		Low 0-3	Med 4-7	Hi 8-10		
<b>B1: Degree of Council Interference/Modification/Use</b>						
Proportion of flow attributable to Council areas - e.g. roads, parks	1.8				18	
Proximity of Council services - e.g. pipe outlet	1.5				15	
Proportion of watercourse already modified for public drainage use	2.0				20	
Proportion of this section of watercourse to the total length	1.2				12	
<b>Sub-Total B1</b>	65					
<b>B2: Extent of Development Effects</b>						
Degree of impermeable development in the catchment above	1.0				10	
Rate of development in the catchment above	2.0				20	
Extent the watercourse is used for authorised private drainage	0.5				5	
<b>Sub-Total B2</b>					35	
<b>Total</b>					100	
<b>Council assistance grant as % of estimated remedial cost:</b>						

### Resource Management Act 1991

Streams are important natural resources for the health and safety of communities, and need to be conserved. Water and soil conservation, formerly assigned its own legislation, is now included in the Resource Management Act 1991 (RMA).

The overall purpose of the RMA is to promote the sustainable management of natural and physical resources. The Act governs all development activities, and its requirements are administered in Auckland by two statutory bodies:

- Auckland Regional Council
- Auckland City Council

As set out in Section 30 (1) of the RMA, Auckland Regional Council has many functions, including:

*“(c) The control of the use of land for the purpose of*

*(iv) The avoidance or mitigation of natural hazards*

*(e) The control of the taking, use, damming, and diversion of water, and the control of the quantity, level, and flow of water in any water body, including -*

*The setting of any maximum or minimum levels or flows of water:*

*The control of the range, or rate of change, of levels or flows of water:*

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

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

*The maintenance and enhancement of the quality of water in that water body:*

*The maintenance of the quantity of water in that water body:*

*The avoidance or mitigation of natural hazards”*

Auckland Regional Council notified the Proposed Regional Plan: Air, Land and Water in October 2001. This document is to assist it to carry out its functions to meet the requirements of the RMA.

The overall management approach for urban streams is to maintain and, where practicable, enhance water quality for the health of the natural ecosystems and for amenity values.

Both the Auckland Regional Council and Auckland City Council have

responsibilities under the act to avoid and reduce natural hazards.

The specific functions of the Auckland City Council are defined under Section 31 of the RMA. Section 31(b) states that every territorial authority has, as a function:

*“ the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards...”*

To carry out these functions, both Councils have produced plans that describe how natural and physical resources in the City will be managed in a sustainable manner.

Section 74 of the Resource Management Act requires that Auckland City’s District Plan is consistent with any Auckland Regional Council Regional Plan and the Regional Policy Statement. This is to ensure that the management of Auckland’s natural and physical resources is integrated.

Section 106(1) of the RMA specifies that Auckland City Council shall not grant a subdivision consent if it considers that either:

*"(a) Any land in respect of which a consent is sought, or any structure on that land is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*  
*(b) Any subsequent use that is likely be made of the land is likely to accelerate, worsen, or result in material damage to that land, other land, or structure, by erosion, falling debris, subsidence, slippage, or inundation from any source"*

will occur unless the Council is satisfied the effects of the proposed subdivision will be avoided, remedied, or reduced.

As far as subdividing and using land goes, Auckland City Council has rules that relate to avoiding or lessening natural hazards. These rules are set out in the Council's District Plan and include minimum freeboard heights in flood prone areas, and restricting activity in land known to be subject to instability. It is important to check with the Council when planning any projects so you can establish whether the land in question has been identified as prone to natural hazards, and if so, what type.

### Resource Consent Applications

Various sections of the RMA detail what needs to be included in a resource consent application. For all

applications, an Assessment of Environmental Effects report (commonly referred to as an AEE) should be provided. This report should reflect the scale and significance of the activity you are undertaking. If it is a large project, a significant amount of information will need to be provided; if it is a small project with limited effects, the AEE can be a lot less detailed. Before spending time and money drafting an AEE, it would pay to arrange a meeting with Auckland City Council and/or Auckland Regional Council staff to find out what either Council considers necessary to be addressed. This can help tailor the AEE to your issues and will help ensure your application is favourably viewed when lodged. Council staff can also explain the consent process and timelines to you, so that you have a fair idea of how long it may take to obtain your consent. For a quick summary of the consent process, the Councils' websites (refer Section 9.1) are very helpful.

### Building Act 1991

The purpose of the Building Act 1991 is to provide the necessary controls over building works, use and safety. Under this Act, the obligations for managing building works in relation to natural hazards are the responsibility of Auckland City Council.

Section 36(1) of the Building Act requires Auckland City Council to refuse the granting of a consent to undertake building works where:  
*"(a) The land on which the building work is to take place is subject to, or is likely to be subject to, erosion, avulsion, alluvion, falling debris, subsidence, inundation, or slippage; or*  
*(b) The building work itself is likely to accelerate, worsen or result in erosion, avulsion, alluvion, falling debris, subsidence, inundation, or slippage of that land or any other property"*

unless Council is satisfied that adequate provisions have been made to protect or restore the land, building work or other property. If the building work will not exacerbate any natural hazard, but the land itself is prone to such a hazard, the Council is able to approve an application for a building consent if it notifies the District Land Registrar. The registrar will then make an entry on the property's Certificate of Title, noting that a building consent has been issued for a building on land that is susceptible to natural hazards.

### C4: Auckland City Consolidated Bylaw 1998 – Part 18 Stormwater Management

The broad objective of Auckland City Council's stormwater management system is to regulate natural stormwater runoff to minimise the adverse effects of stormwater on people, property and the environment.

This broad objective is to be achieved through:

- Ensuring the safe and efficient management, operation and modification of stormwater systems.
- Ensuring development proposals take account of stormwater and stormwater hazard management.
- Controlling erosion.
- Maintaining and, where possible enhancing, freshwater bio-diversity and riparian vegetation.

Specifically, the bylaw places restrictions on, and requires permits for:

- Stormwater drainage works
- Development within (wholly or partly) a flood risk area, flood plain or overland flow path
- Stormwater discharges
- Depositing material, rubbish or litter in or near a stormwater drain in a position where it may be washed into, or impede, the stormwater drain under flood conditions.

# Appendix D

## Planting Guide

This covers the substrates and plants of the stream bank environments found throughout the area. It has been adapted from Auckland City Council's Auckland Isthmus Streamside Planting Guide and Auckland Regional Council's Riparian Zone Management strategy and guideline. More detailed information and other topics covered in these guides include eco-sourcing, planting timetables and the problems of weeds.

### Soil types on stream banks

Across Auckland City, there is substantial variety in the geology and soils. Plants often grow best in a particular soil type. This means it is important to determine the substrate of the stream banks. Four major classes of substrate dominate the isthmus: clay soils, alluvial soils and hard and soft volcanic soils. You can find the soil type that dominates the area around your stream by contacting Auckland City Council or Auckland Regional Council.



### Planting units

A planting site needs to be divided into *planting units*.

The position within a stream's cross-section and the soil type largely determine what species will successfully establish in a planting unit. This is because these factors determine the planting medium, amount of moisture and the erosive power of water flows. Another vital factor to consider is salinity. Inundation of salty water onto stream edges and flats limits the plants that can grow on those areas to those that can tolerate salt.

In general, the stream edge, flood area and back wetland or spring is similar in all soil types. Although volcanic soils are usually highly porous, most of the streams through these soils are in catchments where there are also clay hills. The fine material from the clay hills generally intersperses the volcanic streamside material.

Seven planting units apply to the stream cross-sections and soils found throughout the Auckland City isthmus:

- Stream edge
- Overflow area (flood plain)

- Back wetland (spring)
- Saline stream edge and flat
- Slope - Clay
- Slope - Volcanic (hard and soft)
- Slope - Alluvial

The planting units can be mixed and matched, depending on the stream cross-sectional divisions present (stream edge, overflow area, back wetland and slope) and the substrate (clay, volcanic - hard or soft - and alluvial). Where seawater comes up a stream at high tide, the saline stream edge and flood area planting unit should be applied.

### Stream Edge

The extreme stream edge is frequently damp and is subject to significant erosive forces.

Plants that can survive the dry and sunny conditions along an open stream edge include rautahi, purei, small swamp sedge and giant umbrella sedge. Rautahi has a good ability to spread and stabilise stream edges.

### Overflow Area

An overflow area (flood plain) may be made up of a stream flat and lower bank. In this area away from the channel, the velocity of flow

drops and erosive forces are generally less significant. Overflow areas in all soils can be considered to be alike in planting conditions. They are usually more fertile than the adjacent banks.

During initial re-vegetation, the same variety of sedges that grow well on the stream edge will also grow well in the overflow area. These include rautahi, purei, small swamp sedge and giant umbrella sedge. Toetoe is also an effective species, as it lies down in floods and tolerates harsh dry and disturbed conditions while providing shelter for other species.



Mahoe can be interspersed with toetoe as it forms a very good root system that helps stabilise the bank. Other taller trees can also be planted. Trees that will eventually grow quite large include cabbage tree, putaputaweta, karaka and kahikatea.

### **Back Wetland (or Spring)**

This planting unit applies to clay soils, alluvial soils and volcanic soils. Where streams have changed course, or where springs emerge, there are often areas that remain wet almost all year round.

Plants able to tolerate very wet conditions include purei, rautahi, small swamp sedge, swamp kiokio, and manuka. Trees that will eventually grow quite large include cabbage tree, swamp maire, pukatea and kahikatea.

### **Clay Overflow Area Banks**

Conditions on clay slopes will range from dry at the top to damp at the bottom. Clay is relatively infertile, therefore care needs to be taken with the placement of various species in different positions on the slope.

Toetoe, karamu and flax are all very hardy species that will grow readily on clay slopes. Kanuka, manuka, mahoe, and mapou will survive on clay banks. Large trees that do well on the damper lower slopes of clay banks include karaka, kohekohe,

and puriri. Totara, rimu and kauri will do well from the mid-slope to upper slope.

### **Volcanic Overflow Area Banks**

Volcanic slopes (either hard or soft) differ from other slopes in that they are frequently very rocky. Here, the species that do well on lava flows thrive. These include pohutukawa, mapou, karamu, akepiro, koromiko and akeake.

### **Alluvial Overflow Area Banks**

Alluvial slopes are similar in many ways to both alluvial flats and clay slopes. However, they tend to be drier than alluvial flats - especially near the top - and they are more fertile than clay slopes.

Major species that can successfully be planted on alluvial slopes include toetoe, flax and karamu. Kanuka, manuka, mahoe and mapou are also appropriate - with the first three of these forming very good nursery vegetation. Kowhai, cabbage tree and titoki are all larger trees that can be planted in young plantings.

Planting large tree species into nursery vegetation can encourage forest diversity. Species to plant include karaka, kohekohe, puriri, totara and matai.

### **Saline Stream Edge and Flat**

Saline stream edge and flat planting units are found in the lower reaches of the streams of the Auckland

isthmus. They reach as far upstream as the saline influence of the harbour. Determining the extent of this saline area is not always easy. In some cases native plant species that like a saline environment will be present. In other cases, saline-tolerant weeds will predominate. These include mercer grass, kikuyu, and tall fescue. It is important to identify the extent of a saline unit correctly, as many of the species that are suited to the edges, flats, and back wetlands of freshwater streams will not thrive in saline conditions.

The saline stream edge and flat unit can be replanted with species that are already present in the mature vegetation. All of these species should be able to survive. Jointed wirerush and sometimes sea rush are present on the stream edge, along with saltmarsh ribbonwood.

On the overflow area, marsh clubrush is often present in quantities. Flax and coastal tree daisy are also present, as is pohuehue. Cabbage tree, manuka, pohutukawa and kowhai are often able to survive at the toe of the slope, above areas inundated by salty waters.

Table D1:  
Plant Names

Common name	Botanical name	Common name	Botanical name
Akeake	<i>Dodonea viscosa</i>	Marsh clubrush	<i>Bolboschoenus fluviatilis</i>
Akepiro	<i>Olearia furfuracea</i>	Matai	<i>Prumnopitys taxifolia</i>
Cabbage tree	<i>Cordyline australis</i>	Mercer grass	<i>Paspalum distichum</i>
Coastal tree daisy	<i>Olearia solandri</i>	Pohuehue	<i>Muehlenbeckia complexa</i>
Flax	<i>Phormium tenax</i>	Pohutukawa	<i>Metrosideros excelsa</i>
Giant umbrella sedge	<i>Cyperus ustulatus</i>	Putaputaweta, marble leaf	<i>Carpodetus serratus</i>
Jointed wirerush	<i>Leptocarpus similis</i>	Pukatea	<i>Laurelia novae-zelandiae</i>
Kahikatea	<i>Dacrycarpus dacrydioides</i>	Purei	<i>Carex secta</i>
Kanuka, white tea tree	<i>Kunzea ericoides</i>	Puriri	<i>Vitex lucens</i>
Karaka	<i>Corynocarpus laevigatus</i>	Rimu	<i>Dacrydium cupressinum</i>
Karamu	<i>Coprosma robusta</i>	Rautahi	<i>Carex lessoniana</i>
Karamu	<i>Coprosma robusta</i>	Saltmarsh ribbonwood	<i>Plagianthus divaricatus</i>
Kauri	<i>Agathis australis</i>	Sea rush	<i>Juncus maritimus</i>
Kikuyu	<i>Pennisetum clandestinum</i>	Small swamp sedge	<i>Carex virgata</i>
Kohekohe	<i>Dysoxylum spectabile</i>	Swamp kiokio	<i>Blechnum minus</i>
Koromiko	<i>Hebe stricta</i>	Swamp maire	<i>Syzygium maire</i>
Kowhai	<i>Sophora microphylla</i>	Tall fescue	<i>Festuca arundinacea</i>
Mahoe	<i>Melicytus ramiflorus</i>	Titoki	<i>Alectryon excelsus</i>
Manuka	<i>Leptospermum scoparium</i>	Toetoe	<i>Cortaderia fulvida</i>
Mapou	<i>Myrsine australis</i>	Totara	<i>Podocarpus totara</i>

# Glossary

<i>Alluvial soils</i>	Sediments - mainly silts and sands - deposited by streams in the past	<i>Mitigation</i>	Reduction or moderation of the severity of an effect
<i>Aquatic</i>	Living in the water	<i>Overflow Areas</i>	Areas next to the stream that water flows on to when the stream channel capacity is exceeded
<i>Back Wetland</i>	A small secondary channel or wetted area alongside the main stream channel	<i>Overtop</i>	The flow of water over the top of a stream bank
<i>Clay Soils</i>	Very fine-grained soil	<i>Pallisade Wall</i>	Pole or pile wall completely in the ground with a concrete capping beam
<i>Crustaceans</i>	Hard shelled aquatic animals such as freshwater crayfish (koura) and crabs	<i>Planting</i>	Putting trees, grasses and shrubs in the ground
<i>Culvert</i>	A pipe in a stream designed to convey water under a specific structure (such as a path or road).	<i>Planting units</i>	The area in or near the stream banks where particular plants are placed – see Appendix D: Planting Guide
<i>Ecology</i>	The study of the relationships between animals and plants and their environment	<i>Retaining Wall</i>	A wall built to support the land behind it
<i>Erosion</i>	The process of wearing away soil by water flow	<i>Riparian</i>	Of or relating to, or located on, the banks of a river or stream
<i>Flood area</i>	The land described by the boundary of the maximum probable flood	<i>Saline</i>	Salty water, usually due to tidal flows up the stream
<i>Flood Plain</i>	Any nearly flat lowland that borders a stream and that may be covered by its waters at flood stages	<i>Sediment</i>	Solid material, both mineral and organic, that is in suspension
<i>Flooding</i>	The flow of water over land that is usually dry	<i>Stormwater</i>	Rain once it has fallen on the ground and begins to flow
<i>Gabion Basket</i>	A large wire mesh basket filled with rocks, used to protect and/or stabilise banks	<i>Stream (perennial)</i>	A stream which: appears on the NZMS 260 1:50,000 scale map; and/or has stable pools in late summer; and/or has continuous flow; and/or has any of the following aquatic fauna, native fish (bullies, kokopu, inanga) crayfish, aquatic snails or shrimp, mayflies, stoneflies or caddisflies
<i>Geology</i>	The study of soils and rocks	<i>Stream (ephemeral)</i>	Any stream that is not perennial
<i>Groundcover</i>	Plant cover on the ground, such as grass and low shrubs	<i>Stream Channel</i>	The course followed by water in a stream
<i>Habitat</i>	The natural home of an animal or plant	<i>Stream Cross-Section</i>	The view across the streambed and banks – left and right banks relate to looking downstream
<i>Hapu</i>	Sub-tribe, usually a number of whanau with a common ancestor	<i>Stream Edge</i>	The point up the stream banks usually covered by water
<i>High Flow Water Level</i>	A stream's water level during flood flows	<i>Streambed</i>	The bottom, or base of the stream, usually covered by water
<i>Hydraulics</i>	The study of the flow of water	<i>Structural Solutions</i>	Engineering works in the stream
<i>Hydrology</i>	The study of water on or under the earth's surface	<i>Tangata Whenua</i>	In relation to a particular area, means the iwi or hapu that holds mana whenua over the area
<i>Invertebrates</i>	Animals without backbones, such as snails and worms	<i>Terrestrial</i>	Living on the land
<i>Iwi</i>	Tribe, people	<i>Toe of Stream Bank</i>	The point where the streambed meets the bank in the low flow channel area.
<i>Low Flow Channel</i>	The area of the streambed usually always wet from water flows	<i>Volcanic Soils</i>	Soils formed from volcanic activity in the past, including ash, tuff, scoria and basalt
<i>Mana Whenua</i>	Customary authority exercised by an iwi or hapu in an identified land area	<i>Waterway</i>	A way or channel for conveying water
<i>Mauri</i>	Life force		

