## **APPENDIX A : DEVELOPING A PLAN FOR STREAM MANAGEMENT**



The key to a successful project is good planning, setting realistic objectives, and aiming for continual improvement.

#### STEP 1 – Getting started

- Verify the limits of your property boundary
- Identify any degraded stream features
- Classify the stream into soft- and hard-bottomed sections

• Get a feel for the site and think about how you might like

Contact Auckland Council to verify resource and building

Share your enhancement concept with neighbours - they may want

to be involved in the project and could contribute to the resources

What do you want to achieve? What can you improve?

• Draw a sketch of all of the above

**STEP 2 – Progressing your ideas** 

Set realistic objectives

consent requirements (if any)

Draw a concept plan

it to look and feel when it is finished

Identify any aspects that could be enhanced

Create a photographic record of the stream

#### What is wrong with my stream? What does it look like now?



BOUNDARY.

## Caring for Urban Streams

٠

٠

.

•

٠



#### STEP 3 – Work on the detail

- Create a list of what is required to achieve the objectives
- Make sure all Health & Safety aspects are considered
- Work out whether the project will be simple or complex
- · If complex (requiring specialist input), consult with a registered engineer
- If unsure on consent requirements, contact the Auckland Council on 09 301 0101, and request guidance from Resource Consents and Building Control.
- If necessary, get help from an engineer, arborist, or ecologist, and contact community organisations that may be carrying out similar work in your area

#### STEP 4 – Create a programme

- Set priorities, address the most important issues first Don't bite off more than you can chew!
- · Set objectives that are achievable and easy to monitor
- Decide on a reasonable and practical timeframe for completion
- Make sure ongoing maintenance is included in the programme
- Have realistic time frame some changes will happen quickly but others will take a long time

Priority	What must be done?	When?
1	e.g. Remove garden waste and building rubble from the floodplain	
2	e.g. Plant a 5m vegetated stream margin	Early Autumn
3	e.g. Stabilise toe of stream bank at culvert outfall with rocks	Summer
4	e.g. Create a riffle – ask Auckland Council for advice	Summer
5	e.g. Construct a rock ramp to compensate for the inadequate culvert design – ask Auckland Council for advice	Early spring
6	e.g. Insert a spat rope through the culvert and into the outfall pool	Immediately
7		
8		

#### STEP 5 – Review and update your programme

- Keep an eye on your stream use the initial inspection as a benchmark for future comparisons
- Keep notes of your efforts, including successes and let-downs
- Revise priorities and objectives as you learn about your stream
- Consider where best to allocate your resources and effort

Be patient – whilst some enhancements will result in visible improvements very quickly, others may only become evident after a number of years





### **APPENDIX B : GUIDES - CARING FOR URBAN STREAMS**

Guide 1: Flooding

Guide 2: Erosion

Guide 3: Stream water quality

Guide 4: Stream side planting

Guide 5: Stream life

Guide 6: Fish passage

# Caring for Urban Streams -Guide 1: Flooding

Issued by Auckland Council April 2013

Auckland Council Te Kaunhera o Térnaki Makaurau

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101



It is perfectly natural for streams to overflow as a result of heavy rain, and this is often an important aspect of the local ecosystem. Unfortunately it can become a problem in an urban situation.

Blocking, culverting and filling in streams can make these matters worse, not better, as natural overflow areas are removed and the stream is narrowed. The resulting flooding can be unsafe, damage property and disturb stream and plant life. This guide describes how to manage flood risks in and around urban streams.

#### **STREAM SOLUTIONS**

### Below are several solutions to help manage flooding.

Remove obstructions. Is the stream channel littered with old tyres, rubbish, large branches, overgrown wire fencing or other blockages? These block flows. Walls, fences and other barriers across and alongside the stream channel act as dams and contribute to flooding problems.



Avoid removing natural material in the streambed such as rocks and gravel, submerged logs and water plants, as these help control fast flows and are food sources and shelter for stream life.

Plant stream sides carefully. Are plant pests (willows, pampas grass and bamboo etc) damming water flow? Replace with waterside plants (grasses, sedges and rushes) that lay flat and allow water to flow freely during floods, or trees with narrow trunks such as cabbage trees. Though native, flax can be problem if planted too close to the stream, as it can block flows and trap material which causes flooding. Willow trees cause the same problem.

Improve channel shape. Stream banks may be carefully re-shaped to be less narrow and steep, though this would require consents. Suitable waterside plants should be planted to stabilise bank sides.

#### Caring for Urban Streams - Guide 1: Flooding



Check pipe flows. Look at pipes and culverts in the stream path – do they allow for free flow of water during heavy rainfall? If these frequently block and overflow they may be undersized. Seek engineering advice.

Keep flood paths clear. Inspect overflow routes where the stream banks are overtopped during storms. Can water flow freely? These natural pathways should be kept clear of bulky plant varieties (such as flax), fences and other obstructions.

Digging and piping. Before starting works, is a permit or consent needed? Any earthworks, culverts or piping in and alongside the stream may need council permits or consents. Earthworks usually includes removing artificial fill (concrete, rock, soil), piping or putting in culverts in the stream, and digging out the stream channel to increase water storage. Check with Auckland Council Resource Consents before undertaking any stream earthworks. Maintenance works, to reinstate damaged banks or structures, are permitted.

Flood paths next to streams should have plants that can lay flat during flood flows, rather than include rigid bulky plants.

#### MAINTENANCE AND MONITORING CHECKLIST

It is important to maintain and monitor your stream. Maintaining it will mean that it keeps clear of weeds and other problems, while monitoring will improve your understanding of how it behaves, making it easier to manage in the long term.

#### Maintain:

- Check for blockages in streambed after heavy rainfall.
- Keep streambed and overflow areas/floodplain clear of bulky, rigid plants.
- Trim low level streamside plants to keep overflow areas clear, but keep taller plants to shade the stream.

#### Monitor:

- Watch for rising water levels during storms.
- Put a permanent marker post in streambed to record water levels during floods.
- Record and date flooding and property damage (take photos, keep notes, record levels on post) to check if flood area is increasing or water is taking longer to drain away.



#### Caring for Urban Streams - Guide 1: Flooding



#### **STREAM MONITORING PLAN**

Keeping notes and taking photos and simple measurements on site over time helps identify if flooding is becoming more frequent, more widespread, or taking longer to drain away. It can also help identify local obstruction points, risk to property, and upstream or downstream problems areas.

- Use a notebook to record stream overflow information, including dates, measurements and photos. Note weather reports and rainfall measurements. Remember to include photos of the stream and levels when not in flood.
- Sketch a simple property layout showing the dry weather stream path. Outline overflow areas during storms, and highlight unusually high or widespread flood levels.
- Take regular photos of the same stream section to compare flows. Take mid- to late-summer photos to use as a comparison.
- Record maintenance carried out within the property as well as upstream and downstream.
- Refer to these records to see if flooding has changed following maintenance, or to help identify other factors that could be causing increased flooding.
- Use notes to guide long-term management of stream and to support professional advice or work on stream.



#### **Links/Further Information**

Areas prone to flooding are indicated on the Land Information Memorandums (LIMs).

Further information on flooding can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- Flood risk
- Mitigation
- Stormwater

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage

The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



# Caring for Urban Streams – Guide 2: Erosion Issued by Auckland Council April 2013

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101



Erosion and sediment deposition are natural and important aspects of streams, however sometimes these processes can result in significant problems in an urban setting, especially when unnatural flows occur in streams.

Urban stream systems often have to deal with extra sediment from surrounding land development and faster and higher flows of rain run off as a result of land becoming covered in hard impermeable surfaces.

Ongoing excess erosion and sedimentation in urban streams can cause significant damage to property, natural freshwater and marine habitats. This guide describes how to manage erosion in urban streams.

#### **STREAM SOLUTIONS**

# Below are several solutions to help manage erosion and sedimentation.

Remove obstructions and slow flows. Are flows concentrated in some areas? Obstructions and narrow channels increase the speed of flow and erosive power, especially during rainfall events.

• Remove litter, large logs and bulky rigid plant species if these narrow the streambed or restrict flow. Replace with dense planting of softer plants such as rushes and reeds.



- Carefully dig out by hand and reinstate bankside soil that has slumped into the streambed, but do not dredge the streambed using machinery.
- Leave small rocks and gravel in the streambed as these help slow flows and protect the streambed. Place small rocks along the stream bank, especially on outside bends, to reduce erosive power. Larger rocks and logs secured across a streambed can slow flows in areas where flooding is not a risk, and can protect stream beds. (A log should be longer than the width of the stream, of diameter of 100mm or more, set diagonal to stream flows and fixed at upstream end to prevent movement.)
- Check that flood plain areas are clear of obstructions erosion controls can slow water flows, making it easier for streams to overflow during heavy rain.

Stabilise banks. Are the stream banks eroding or slipping? Supporting the stream banks and bed can reduce erosion. Some of this work will require engineering advice and resource consents.

• Stabilise slipped or eroded banks using geotextiles to support soil, and then plant. Gently rework the slope of steep-sided stream banks; however remember to put in silt fences and other sediment control protection to keep soil out of the stream.

#### Caring for Urban Streams - Guide 2: Erosion





- Prevent erosion by careful placement of rocks, planting or by using gabion baskets (heavy wire netting filled with rocks) at the toe of the stream bank, especially on outside bends. These measures can also be used to support collapsing streambanks.
- Flatten steep sections of streambed to slow flows, by placing piles of rocks across the width of the stream bed to form a shallow weir. Use geotextiles under rocks to stop scouring during high flows.
- Saturated soils at risk of ongoing slumping may need to be drained using buttress drains (small trenches in bank dug below slip level, filled with free draining gravel or scoria, and fitted with slotted drain pipe) – seek engineering advice.

Plants and mulch. Are plants supporting the stream banks? Native waterside plants, especially on the outside bends of the stream, help prevent erosion of stream banks and nearby ground by slowing flows, spreading runoff and protecting surface soil.





- Remove pest species willow trees can worsen erosion over time so should be carefully removed.
- Protect bare ground to avoid soil loss. Use geotextiles if possible. Planning earthworks. Before starting works, is a permit or consent needed? Is good weather forecasted?
- Always check with Auckland Council Resource Consents before undertaking any stream works.
- When possible, work in late summer to avoid overlap with fish migration and spawning, and high water flows.
- Check if consent is needed for earthworks. Earthworks can include digging out streambed material, putting in rocks or weirs and supporting stream banks.
- Get engineering advice severe erosion threatening property, services, and health and safety may require structural engineering work such as retaining walls, hard lining or gabion baskets.



#### **Maintenance and Monitoring Checklist**

Regular maintenance and monitoring is important in preventing erosion, as flow rates vary over time and changes up or down stream can change the behaviour of the stream significantly.

#### Maintain:

- Check erosion controls (rocks, plants, logs) have not washed downstream.
- Check for slippages after heavy rainfall.
- Check retaining structures are in good condition.

#### Monitor:

Erosion control on a small section of a stream will not solve upstream erosion problems; however it can help slow flows and reduce silt build-up downstream and in marine areas. Monitoring changes to the stream during and after erosion control helps identify what is happening to the stream along its entire length.

- Record changes to stream bed and banks erosion, slumping, flooding, muddy sediment. You can make notes, take photos, draw a plan of the stream.
- Annotate the plan, recording changes in stream position and character over time. If there are problems concerning the stream these records may be very important.
- Watch for streambed being smothered in silt and if it is, record any changes of depth of silt.

#### WORKING IN STREAMS

Disturbing streambeds and banks can cause more erosion and sediment loss. By working carefully, this can be avoided.

- Manually dig out slipped material, or slope stream banks to protect against further erosion and sediment loss.
- · Work in late summer to avoid migrating and spawning fish
- Complete work in the dry season (summer) and protect bare areas as soon as possible to avoid washout during works.
- Put in temporary rock weirs to settle sediment during works so it does not wash downstream.
- Use sediment controls such as silt fences when working on stream banks (when removing slipped areas, supporting toe of bank, while planting, fixing logs, rocks, and geotextile materials).
- Leave as much streamside planting as possible, or replant with suitable varieties (non-bulky native plants, with dense root systems and flexible stems or leaves, that will lay flat during overflows).

#### Links/Further Information

Further information on erosion and sedimentation can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- Erosion
- Sediment
- Stormwater
- Stream facts Works Within a Watercourse Erosion and Sediment Controls
- Technical Publication 90
- Erosion Control Auckland

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage

The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



# Caring for Urban Streams – Guide 3: Stream water quality Issued by Auckland Council April 2013

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101



The quality of our coastal environment is directly related to the quality of our streams because what enters our streams enters the sea. So if we want clean and safe beaches we need to have clean and safe streams.

All kinds of pollution wash into streams, from building wastes, gardening and cleaning products, to heavy metals, fuel wastes and silt washing off roads and surrounding land. If conditions are right, stream beds and the plants alongside can trap, settle out and absorb pollutants before they flow downstream and into marine areas. Signs of a healthy stream include a natural stream bed, plant cover on stream bank, and a diverse and active ecosystem. This guide describes how to create conditions to improve water quality in urban streams.

#### WHAT STREAM FEATURES IMPROVE WATER QUALITY?

- Shallow areas flowing over gravel or rocky areas (riffles) oxygenate water
- Plants within the stream and on its banks help filter flows and shade it to keep water temperatures cool.
- Natural levels of algae.
- Biofilms on surfaces in the stream bed a thin slime layer on stream banks, rocks, and plants, made up of bacteria and other organisms that trap and break down pollutants in the water.



#### **STREAM SOLUTIONS**

Below are several solutions to help manage stream water quality.

**Filter flows.** Filter water entering the stream. Planting alongside the stream, known as riparian planting, traps pollutants and acts like a sieve, allowing cleaner water through. Even a simple grass strip can act as a screen to reduce pollution getting to the stream from hard surfaces such as driveways.

**Care for stream bed**. Is the stream bed and banks stable, and is stream water usually clear, not muddy? Reducing pollutants (including silt) washing into the water helps improve water quality downstream.

- Monitor and fix erosion using streambank planting and by slowing flows. (See Guide 2: Erosion).
- Check the stream has some rocks, logs and riffles (gravel, pebble and small rocks spread across shallow areas). Rocks and riffles oxygenate the water, make a home for water animals and encourage the growth of native water plants and biofilms.
- Shade the stream bed to reduce water temperatures by planting evergreen native plants near the stream.

Keeping pollutants out. What is polluting the stream? Gardening and cleaning products pollute streams and kill stream and marine life, and too much sediment smothers life.

- Do not use herbicides, pesticides or fertilisers within 10 metres of a stream.
- Stop wash-off from building work or cleaning activities (e.g. car washing, water-blasting) from draining to stormwater drains and streams, including cement, paint products, fuel products and car wash detergents.
- Keep pet waste out of streams.
- Never dump waste into stormwater drains or streams report dumping and stream pollution to Auckland Council Pollution Hotline 09 377 3107.

#### Maintenance and monitoring checklist

Regular maintenance and monitoring is important in ensuring that stream water quality is good. Changes made up or down stream can alter the stream quality for the entire length of the stream so monitoring gives us an understanding of what is happening. We may only see the symptoms, but proper maintenance ensures that pollutants are not entering the stream from the land.

#### Maintain

- Remove rubbish that has washed into the stream.
- Replace gravel in shallow areas and reinstate and anchor water plants and rocks that have washed downstream.
- Ask a horticulturist or landscaper for a suitable plant list which grows well on stream bank, results in a dense permanent ground cover, and can live in partial or full shade.
- Reinstate slipped stream bank material by hand in dry season.

#### Monitor

- Observe and record water life passing through and living under gravel, rocks and plants – larval insects, tiny crustaceans, migrating fish, and especially sensitive water creatures, are indicators of stream health
- Look at the stream bed have rocks washed downstream? Replace and secure in place.
- If riffles are washed away, consider replacement with larger rocks.
- Check stream banks are not being eroded or slumping, and stream bank plants are not falling into the stream.
- Make note of sudden or noticeable new silt accumulation.

- Encourage plant growth alongside stream.
- Aim for shading but keep overflow paths clear of large obstructions.
- Measure stream water temperatures monthly (especially at midday) – ideally should be below 20 degrees Celsius.
- Note signs of pollution and take photographs. Signs include unusually muddy water, discolouration, foams, and oily sheens. Report large-scale fish deaths immediately to Auckland Council.
- Report stream pollution to Auckland Council Pollution Hotline 09 377 3107
- Maintain bankside grasses, sedges and rushes, and keep taller plants with spreading canopies to shade stream – even one row of trees and shrubs helps.

#### Links/Further Information

Further information on water quality can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- Streams
- Water quality
- Pollution

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage

The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

## For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



# Caring for Urban Streams – Guide 4: Stream side planting Issued by Auckland Council April 2013

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101



The right choice of streamside planting can help control flooding and erosion, improve water quality and stream life, reduce pollution in the stream and marine environment, and enhance the appeal of your property.

Auckland stream beds vary, from steep to gently sloping, from silty and clayey to volcanic and sandy. However, a number of plants are common to all of these streams. The area around waterways is known as the riparian zone, including the stream banks, overflow areas and the slopes on either side of the stream. This is a general guide on planting in riparian zones.

#### **STREAM SOLUTIONS**

# Below are several solutions for planning and maintaining riparian zone planting.

Make a planting plan. Is the existing riparian planting the best for you and the environment? Are you getting the most benefit from the plants next to your stream? Creating a planting plan will show what riparian zone plants are suitable, what to replace and how.

 Set out a plan on paper for the stream including stream bed and surrounding area. See the diagram on the next page, refer to Auckland Regional Council Technical Publication 148 Riparian Zone Management, and get advice from a local nursery or arborist.



- Use locally grown native plants these need less watering and grow well in the area.
- Find out what type of native plants suit particular stream zones. For example, Carex sedges, giant umbrella sedges and native toe toe planted at the stream edge survive floods and offer fish habitat. Check the area has no poisonous or invasive weed species.
- Choose hardy fast-growing native colonising varieties (such as tea tree, cabbage trees, sedges and rushes) for first plantings, followed with secondary diversity plantings of less hardy plant species. Some plant varieties are best suited to the water's edge and stream bed, while others do best on banks and in flood plain areas.
- Aim for riparian zones with variety different heights and shapes, climbers, ground covers, mosses, ferns and hanging plants, and native flowering plants to attract birds and insects. Perennial plants are preferable over annuals. Planting encourages life in the water and surrounding areas, and is more appealing.
- Plan to plant between existing vegetation fill gaps, reinstate native plants where weeds have been removed, add features, and replace plants not growing well.
- Establish ground cover plants before unwanted trees are removed, if possible. Thin out unwanted trees, rather than



cut them all down at once, so that the soil is protected from erosion and the stream remains shaded. Weeds can offer shelter and protect soil while plants establish.

Connect planting. Does the planting link with neighbouring planting?

- Just a metre wide strip along the length of a stream improves the stream substantially.
- Fill gaps upstream and downstream, and connect planting to neighbouring gardens and parks to create a continuous riparian zone.
- Link surrounding flood plain areas to the stream by planting from flood plain areas right up to the water's edge.
- Include attractive plantings and natural accesses to shallow parts of the stream, to provide a space where you can easily and safely reach and enjoy the stream.

Keep watch. Is riparian planting getting too dense? Dying? Causing flooding or erosion? Are weeds taking over?

- Store garden waste well away from stream side pest plants and weed seeds spread easily.
- Replace pest plants such as willow trees these cause erosion and block flows.
- Plant vegetation on bare earth to stop erosion and sediment washing into the stream.
- Do not spray pesticides and herbicides near stream when washed into the stream they kill water life and plants downstream. Do not fertilize ground near the stream – this causes stream algae and pest plants to thrive.
- Water new plants until established.



#### Maintenance and monitoring checklist

Proper maintenance and monitoring ensures that the stream stays healthy and protects the values provided by the planted stream area.

#### Maintain

- · Keep new plantings well watered.
- Remove new arrivals of weeds and animal pests.
- Watch for native seedlings establishing naturally and keep weeds clear of the seedlings.
- Replace dead plants with varieties more suitable for the position on the streamside.

#### Monitor

- Record and photograph planting are some varieties doing better than others? Are they in the right position on the stream?
- Watch for weeds establishing from upstream or downstream areas.
- Record the variety of plant and animal life in the riparian zone and note improvements after planting and care.

#### Links/Further Information

Further information on stream side planting can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- TP 148
- Native Forest Restoration
- Pest plants
- Biosecurity
- Weedbusters
- Freshwater weeds

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage





The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



# Caring for Urban Streams -Guide 5: Stream life

Issued by Auckland Council April 2013

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101

Healthy streams not only support a wide variety of native freshwater and terrestrial wildlife, they also support the ecosystems of our marine environments. A large proportion of marine fish species live in both environments during different periods of their lifecycles.

There is a strong connection between the life in the stream and the life on the land, as insects exist in the streams as eggs and larvae but live out of the water when they emerge as adults. Birds, insects and fish life feed on these insects, and birds and flying insects pollinate plants in areas around the stream.

This guide describes how to improve biodiversity in urban streams.

#### **STREAM SOLUTIONS**

Plants and animals migrate using wildlife corridors such as streams and planted areas, so even short sections of good riparian planting and healthy stream bed and banks will improve ecology by connecting places to live, feed and breed.

**Plant banks and edges.** What is planted around and alongside the stream (the riparian zone)?

- Aim for variety different heights and shapes, decidious and evergreen, climbers, ground covers, mosses, ferns, hanging plants and native flowering plants to attract birds and insects.
- Shade the stream with tall trees as well as hanging bank side planting this reduces water temperatures, shelters stream animals, and reduces algae growth.
- Encourage native mosses and liverworts (bryophytes).
- Plant the stream edge with plants such as Carex sedges, giant umbrella sedge and native toe toe these feed and shelter native fish, and provide spawning sites.
- Plant water loving plants some plant species grow well partially or completely submerged in the water. These connect the edge of the water to the stream bed, offer pathways, and help filter pollutants.

**Connect.** Does stream side planting connect with plants on banks and surrounding areas?

- Link planting along stream banks, across flood plain areas, to surrounding gardens and slopes.
- Plant varieties that do not block flows in overflow and flood areas – grasses, sedges and rushes lay flat so water flows freely, and water flows easily around trees with narrow trunks, such as cabbage trees.



Aucklan

Counc

**Remove pests and weeds**. Are these stopping local animal and plant life from flourishing?

- Remove invasive weeds, starting with the most widespread weeds first.
- Control animal pests by carefully trapping or using bait stations, making sure that poisons do not end up into the water or kill native species.
- Carefully replace weeds with native plants however, make sure you do not remove important habitat for native fish and other water creatures that may already live there.

#### Caring for Urban Streams - Guide 5: Stream life





Feed animal life. What can animal life feed on in the area?

- Select plants on which native birds and insects feed seasonal nectar, pollen and fruit bearing plants.
- Plant stream bed and banks to support a variety of insect life. Some water insects emerge as adult flying insects, feeding and breeding in areas around the stream. These insects in turn are food for birds and other stream life, and pollinate plants. Water insects feed on leaf litter, water plants, algae, and smaller organisms, and are food for fish and other water life.
- Understand the cycles insects and birds help pollinate plants that feed other birds and insects that carry seed to new areas to grow it is all connected.

**Create habitat.** What makes the stream more suitable for biodiversity?

- Large woody debris placed into the stream will promote retention of finer woody debris, the formation of meanders, and creation of shallow areas and deeper pools
- Tree stumps can be inserted upside-down into the stream bank, such that roots create overhangs in the stream
- Build artificial riffles between stream bends or add gravel to





already developing natural riffles

**Stream bed and banks biodiversity.** Material on the bed and banks of the stream provides food and shelter for water life.

- Natural debris. Twigs, leaves and other natural dead plant materials shelter, feed and shade animal life. Do not remove this debris unless it is causing flooding.
- Water plants. Some grow in and under the water and others in waterlogged soil. These plants offer shade, food, shelter and breeding sites for water life.
- Stream bed materials. Whilst some insects prefer to live in muddy areas, a greater diversity live in the faster flowing gravel and sandy patches in a stream, where the water is better oxygenated, there are spaces to hide, and available food (mosses, algae, tiny animals). Although some fish species seek out these faster-flowing areas, deeper slow flowing pools are preferred habitats for adult eels and some fish species. A variety of habitats is ideal.
- Logs and rocks. Large logs and boulders in the stream form deeper pools, anchor water plants, trap leaf litter and form riffles. Logs should be angled diagonally down stream to avoid blocking flows in heavy rainfall and should be anchored on at both ends by burial or pinning to bank.



#### Maintenance and monitoring checklist

Proper maintenance and monitoring ensures that the improved habitat is kept clear of weeds and helps you understand how the habitat is improving and where work may still need to be done.

#### Maintain

- Maintain your riparian planting and include a long term weed management plan.
- Pay specific attention to emergent and hydrophilic plants, as well as submerged and floating water plants.
- Re-anchor or reinstate large woody debris if this is dislodged or washed downstream in a large storm event.
- Remediate any bank slumping and undercutting.
- Maintain any infrastructure necessary for fish passage.

#### Monitor

- Record what you see (birds, plants, fish, insects in and around the stream) – a wide variety of steam life, especially sensitive insect and fish species, shows the stream is well shaded, has food and shelter, and has good water quality.
- Take photos of stream and surrounds especially before and after planting and weed and pest control.
- Look for weeds and pests, and maintain bait stations.
- Check after heavy rain for erosion on stream banks and bed, and movement of in-stream structures (logs, rocks, gravel areas, plants) – these are shelter for stream life.



#### Links/Further Information

Further information on stream biodiversity can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- Macroinvertebrates
- Waicare
- Freshwater fish
- NIWA
- · Wildlife and your backyard
- Monitoring and assessment freshwater
- Stream Ecological Valuation
- Riparian Management

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage



The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



# Caring for Urban Streams -Guide 6: Fish passage

Issued by Auckland Council April 2013

This guide forms part of a larger series of documents under the banner "Caring for Urban Streams". To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides, and as a starting point look at the Quick Reference Guide. If you have any questions about this information sheet please contact Auckland Council on 09 301 0101



Streams and the fish that live in them are an essential link between marine and land-based ecosystems, so looking after them has a very real impact on the marine environment.

Over a dozen New Zealand fish species move between the sea, estuaries and freshwater streams and rivers at different times of their lifecycles. They generally swim, climb, jump and worm their way upstream in spring and early summer as juveniles, or move downstream between autumn and spring as adults or larvae. Fish passage can be blocked by very fast flows, shallow water, culverts, pipes, concrete channels, ponds, steep cascades, weirs and waterfalls.

There are some simple solutions for backyard streams which ensure that fish do not get blocked from their journey up or downstream. This guide decribes how to improve fish passage in urban streams.

#### **STREAM SOLUTIONS FOR FISH**

Below are several solutions to improve fish passage upstream or reduce impacts on migrating fish.

Good timing. Is it spawning or migration season? If so, put off stream works. Work in streams or areas flowing to streams can cause problems for fish. Work in the stream bed and on banks, and removal of water plants, removes habitat and shelter and causes erosion. Eroded sediment can muddy water dowstream, smother the stream bed and harm stream life.



Aucklan

Clear blockages and deal with obstacles. Are pipes, culverts or channels blocking fish passage? Ideally there should be no drops (sudden changes in level causing small waterfalls, even 10cm drops) and no dry or very shallow sections in pipes or culverts. Culverts and pipes can be designed to allow fish passage – seek professional design advice before installing or altering existing structures in or close to the stream.

For existing pipes and culverts in streams, there are some simple rules.

- If possible, replace culverts and pipes with natural stream bank areas.
- Construct bridges rather than culverts
- Slope box culverts to one side, or form a dish, to create a permanently wet surface.
- In a row of parallel pipes, position one lower than others to carry deeper flows at all times.
- Remove all overhangs, drops and falls on pipes and culverts.
- Set culverts and pipes lower than the natural streambed to carry flows at all times deep enough so some streambed material collects in the base.
- Angle culvert inlets diagonally to natural flow and include headwalls to create a corner that slows the stream current



- Design culverts and pipes with smooth rounded edges, wet outflow margins and low flow sections.
- Put in a fish ladder, spat rope or rock ramp to fix overhangs.
- Size pipes and culverts to be less than half full in spring (during fish migration season)

Slow flow and reduce steep sections. Do steep sections and fast flow sections of the stream have resting pools? Native fish cannot swim upstream in water flowing faster than one metre per second for any considerable distance and cannot climb long steep sections.

- Slow flows by putting in rough beds gravels, water plants, woody debris and rocks disrupt fast flowing water.
- Add measures such as baffles or spat ropes on culverts or pipes longer than two metres, to create rest areas.
- Strengthen streambed and banks at downstream edge of culverts and pipes with rocks and boulders to reduce erosion.
- Form outlet pools in streambed using shallow rock weirs this slows flows and creates resting areas.



#### Fish passage structures

A single 10cm drop in a stream can block fish making their way upstream to complete their lifecycle. Fish passage structures can bridge drops and create rest areas through fast flows and up long, steep sections. Seek expert advice before putting these in place.

**Fish ladders** – steps and lower gradient slopes alongside fast flowing steeper areas give fish an easier passage upstream

**Spat ropes** – climbing fish species can use these to make their way through faster flows and up steep sections

**Baffles** – formed ridges or knobbled areas on the inside of culverts and pipes slow and spread flows so fish can make their way through.

**Backwatering culverts and pipes** – set slightly below downstream flows, these always remain wet, have slower flowing water, and collect sediment and woody debris in the base, helping fish passage. Arch culverts that leave the original streambed in place are preferable to box culverts or pipes.

**Rip-rap** – rocks and boulders placed immediately downstream of a culvert or pipe to stop erosion, formation of drops, and to slow flows.



#### Caring for Urban Streams - Guide 6: Fish passage



#### Maintenance and monitoring checklist

Proper maintenance and monitoring is needed to ensure that your investment has a lasting impact. It is also a great way of getting to know more about the environment.

#### Maintain

- Replace rocks and boulders at outlets that have shifted after storm flows.
- Check weirs are still forming outlet pools.
- Make sure the downstream end of the culverts sit below downstream streambed level, and remain wet at all times.
- Check fish ramps, ladders, spat ropes and weirs are in good condition.
- Repair slips and erosion at culverts and pipes.
- Leave pebbles, gravel, woody debris and water plants in streambed unless a recent build up has become a flood risk.

#### Monitor

- Inspect culvert and pipe outlets before the peak fish migration season (spring and early summer) and repair overhangs or other blockages to fish passage where necessary.
- Note new erosion, especially at culvert and pipe outlets, and repair.
- Watch out for several fish congregating downstream of an in-stream structure – this may be because the structure is blocking migration.

#### Links/Further Information

Further information on stream biodiversity can be obtained by entering the following search terms on internet search engines:

- Auckland Council
- Fish passage
- Culvert barrel design
- Fish passage NIWA
- Fish passage TR2009/084
- Fish passage culverts DOC
- Inlet and Outlet TR



For information on potential fish passage solutions, visit: www.youtube.com/watch?v=qGuA\_zelEjM&feature=related

www.youtube.com/watch?v=QxiwcvmA3uc

http://www.stuff.co.nz/national/videos/3578748

http://www.youtube.com/watch?v=7NYja8ARhzA

http://www.waikatoregion.govt.nz/Environment/Naturalresources/Water/Freshwater-wetlands/Wetland-plants-andanimals/Fish-access/

There are more guides available in this series. The complete set includes the following:

Caring for Urban Streams Quick Reference Guide Guide 1: Flooding Guide 2: Erosion Guide 3: Stream water quality Guide 4: Stream side planting Guide 5: Stream life Guide 6: Fish passage

The activities described in this document include some activities that are minor and easy to do, but may also involve significant construction activity such as the use of machinery, moving large volumes of material and extensive changes to the shape and character of a stream. Such activities are likely to require resource consents. Professional advice should always be sought before commencing any work. If in doubt, please contact the Auckland Council stormwater team.

Remember, private landowners are responsible for maintaining the streams passing through or adjacent to their property and for ensuring that any work is done in a legal and safe manner.

For access to this information sheet and to find the other information sheets, search for "Caring for Urban Streams" at www.aucklandcouncil.govt.nz



## APPENDIX C : QUICK REFERENCE GUIDE





#### If you have any questions about this information sheet please contact Auckland Council on 09 301 0101

A stream in a property can be a real asset, which if managed properly can add a lot to your garden, making it more appealing for you and native wildlife alike.

Proper stream management can also help manage flood risk and reduce erosion, both important concerns for many streamside residents. It is also the responsibility of the landowner to make sure that the stream isn't blocked and does not cause problems for neighbours. The best way to manage a stream is to use nature to do the work for you. The right selection of plants, combined with the careful placement of rocks and logs, can often achieve the same result as more expensive engineered solutions such as concrete channels or culverts, and do so in a more environmentally friendly way.

This guide will give you some ideas about how best to manage your urban stream to reduce flood risk and erosion, enhance your home's appeal, and bring nature into your garden all at the same time.

#### WELL MANAGED URBAN STREAMS

AVOID CREATING UNNECESSARY HARD STRUCTURES

Hard surfaces around streams, like asphalt or concrete, create more stormwater run off which carries pollution directly into the stream, ultimately ending up in the sea. Also flows coming out of a concrete channel are unnaturally high, which causes damage to wildlife habitat and creates erosion problems downstream.

#### **KEEP IT COOL, PROMOTE SHADE**

Planting the right variety of native plants around a stream creates shading, enhancing stream habitat for wildlife.

#### SOAK IT UP

Soil and native plants are great for soaking up and holding back rainfall. This water seeps into the soil, contributes to groundwater, and sustains streams during dry spells. This decreases the volume of surface water, thereby reducing flood risk and pollution.



#### LOCATION, LOCATION, LOCATION

The mix of stream and native plantings makes a garden ideal for birds to raise their young as they seek out best combination of shelter and food. At the same time, well-managed natural areas on a property make a site more desirable for residents, which is reflected in higher property values.

#### **ROCK AND ROLL**

A few well placed rocks or logs can make a big difference to the health of a stream, as they prevent erosion by slowing down streamflow, help oxygenate the water, and create habitat, all of which are good things for aquatic animals.

#### **HELPING HANDS**

Some work to improve a stream may require more than advice from a pamphlet and require more than a weekend's work. Severe erosion may require engineering works that need consenting. If you think that you may need such help Auckland Council is a good place to start the process as our team may be able to provide advice and point you in the right direction.

#### **KEEPING CHILDREN SAFE**

Some parents worry about children living next to streams. Educating your children is the best way to reduce this risk. If fencing is preferred, it is best to erect fences outside of the floodplain area, and build fences parallel to the flow of the stream. Fencing off the stream with a wire fence is better than a solid barrier - timber fences or brick walls can obstruct the flow of water and create a flooding risk.

#### **BE A TIDY KIWI**

Keep the stream free from obstructions such as garden waste and fallen trees, as these create flood risks and may prevent wildlife from swimming upstream. Remember you are legally liable if this obstruction causes a problem on your neighbour's land. Litter can also pollute streams.

#### HOLDING IT TOGETHER

Careful selection of native plants can make a big difference to the stability of stream banks as their roots hold the soil together and plant cover dissipates rainfall energy. They also improve soakage of water into the ground, reducing surface water flows, which mitigates flood and erosion risks. Less permeable surfaces such as retaining walls concentrate flows, making them more erosive and increasing flow velocities.

#### FROM YOUR GARDEN TO THE SEA

Remember, if it goes in the stream it flows to the sea - so restrict the use of chemicals such as detergents, fertilisers, herbicides, pesticides and insecticides to areas of the garden away from the stream. Although the plants are able to filter some of the chemicals, there will be some that will enter the stream and degrade the ecosystem.



#### **NEW NEIGHBOURS**

A well planted and managed stream can be a haven for wildlife and bring a wide variety of life into your garden, from iconic native New Zealand birds such as the tui or the kereru to the tiniest fresh water shrimps and even smaller aquatic creatures.

Regardless of their size, they all have an important role to play in your stream's ecosystem, a cycle that connects your garden with our precious coastal environment.







#### FINDING OUT MORE INFORMATION

Auckland Council's Caring for Urban Streams range of guides is a good source of information if you want to find out more about managing your stream.

They cover a range of topics, depending on what your priorities are.

- 1. Flood risk
- 2. Controlling erosion
- 3. Improving water quality
- 4. Planting
- 5. Increasing biodiversity
- 6. Enhancing the aquatic environment

There is also a larger document, Caring for Urban Streams which provides a more technical and detailed background to improving Auckland's streams. To get an overall understanding of the issues related to stream management it is recommended that people read through the complete set of guides.

To access these documents please

visit www.aucklandcouncil.govt.nz/stormwater









### ACTIONS NEEDED TO KEEP A STREAM HEALTHY AND SAFE

- 1. Wash water flowing onto lawn
- 2. Garden chemicals applied far from stream
- 3. Silt fence in place around construction
- 4. Covered stock pile
- 5. Building not in floodplain
- 6. Natural floodplain left alone
- 7. Fences in floodplain let water through
- 8. Use fences to keep kids safe
- 9. Bridge rather than culvert allows a more natural flow
- No barriers to fish culverts gently sloping and not perched
- 11. Use soft engineering and natural materials

### SIGNS OF A HEALTHY STREAM

- 12. Deeper water and pools
- 13. Natural features such as meanders and stony / rocky sections
- 14. Native plants
- 15. Stream shaded by trees and shrubs
- 16. Logs, sticks and leaves along stream bed
- 17. Cool, clear, flowing and odourless water
- 18. Stones and plants not covered in silt
- 19. Algae and water plant growth similar between winter and summer
- 20. Natural habitat for birds and other life
- 21. Many different fish, water insects and other aquatic animals
- 22. Litter free and attractive environment













### ACTIONS THAT HARM STREAMS AND ARE UNSAFE

- 1. Wash water flowing into stream
- 2. Garden chemicals applied close to stream
- 3. Exposed earth allowed to wash into streams
- 4. Uncovered stockpile
- 5. Buildings in flood plain
- 6. Earth works in flood plain
- 7. Fences in flood plain don't let water through
- 8. Unfenced streams can be dangerous places for unsupervised children
- 9. Structures in the stream affect flows
- 10. Barriers to fish culverts steep and perched
- 11. Use of hard engineering and materials

#### SIGNS OF AN UNHEALTHY STREAM

- 12. Few deep pools
- 13. Few natural features such as meanders and stony / rocky sections
- 14. Weed plants, blocking flow and harming native plants
- 15. Stream banks unplanted and providing no shade
- 16. Plant debris piling up and causing flooding
- 17. Warm stagnant water with bad odours
- 18. Stones and plants covered in silt
- 19. Excessive algae and water plant growths in summer
- 20. Stream banks eroding and undermining the ground and structures
- 21. A wide channel with shallow flows most of the time
- 22. Rubbish and dumped material causing blockages

