PROJECT TWIN STREAMS WAITAKERE

Project Twin Streams Report Card

Introduction

Imagine a network of clean, fish-filled streams with bush-lined corridors, linked together by a network of paths and cycleways...this is the vision of Project Twin Streams.

Project Twin Streams is an innovative partnership between the Waitakere City Council and the local community to restore green networks along streams in the Henderson and Huruhuru catchments. The project aims to achieve better stormwater management, improve water quality, help restore the natural environment, and work with other parts of the council to help create different ways to live, work, play and travel.

A Pressure-State-Response monitoring programme has been put in place to measure progress towards this vision. This report card presents the results of monitoring surveys from 2003 to 2004.

"Pressure-State-Response" Monitoring

The Pressure-State-Response (PSR) model recognises that human activities such as residential growth put pressure on the environment, affecting the quality and quantity of natural resources.

PSR monitoring provides a framework to gauge the cause and effects of environmental problems so that relevant steps can be taken to reduce or prevent the effects on the environment. "Responses" (actions) include Council policy and management actions, as well as local community initiatives.

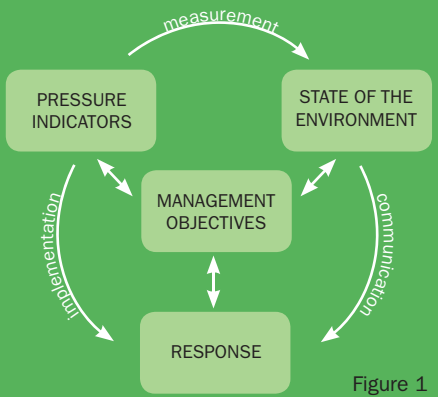


Figure 1

What is an "indicator"?

Indicators measure performance – they 'indicate' how well the objectives of the project are being met. They give us a simplified view of the overall status of the project and highlight any trends which might be occurring within the environment.

The PSR framework for Project Twin Streams uses a variety of indicators (see page 2).

Why undertake a monitoring programme?

Measuring and tracking the successful achievement (or otherwise) of Project Twin Streams is essential. Regular monitoring reveals whether goals are being achieved and allows room for the modifying of plans if progress is not going as expected.

The Council has adopted a 'Pressure-State-Response' model for monitoring (see figure 1).

What do we measure?

Regular long-term monitoring is essential for detecting changes to water quality and the ecosystem. The Project Twin Streams aquatic monitoring programme assesses various water quality characteristics for recreational use and a healthy ecosystem.

What are the objectives of the Aquatic Monitoring programme?

- To measure the effectiveness of pressure changes in the Opanuku and Oratia Stream catchments
- To measure the effectiveness of stream enhancement initiatives for the Opanuku and Oratia Stream catchments
- To measure the expected outcomes of the Project Twin Streams initiatives and identify how well they are achieved

Project Twin Streams Pressure Indicators

- **Impervious Area:** The proportion of the catchment covered by roads, roofs, driveways and other non-natural, impervious surfaces.
- **Wastewater Overflows:** The number of sewer blockages resulting in wastewater overflows into streams for the period of December 2003 to April 2004.
- **Stormwater Outlets:** The number of stormwater outlets greater than 375 mm diameter.
- **Traffic Activity:** Calculated by multiplying the road length (km) by the Average Daily Traffic (ADT) counts, to give Vehicle Kilometres of Travel (VTM) for roads.
- **Riparian (stream bank) Width:** The percentage of the catchment stream length with riparian zones less than 10m wide (from District Plan maps).

Pressures

Measuring and monitoring pressure-indicators is new to New Zealand, so while it has not been possible to collate information on all pressures we have gathered data on a selection of pressures that we know influence stream ecosystems. The results are detailed in the table below.

Where do we monitor?

The locations of the sample sites we will be monitoring are shown in Fig. 2. These sites have been selected based on:

- Land use (a key factor in water quality and ecological condition)
- Stormwater management units
- Proposed responses to the pressures on the environment.

Sites representing bush-clad headwaters, rural, rural/urban fringe, and urban land uses have also been included so the effects of associated environmental pressures can be assessed.

Analysis

The pressures occurring in the Waikumete Stream system are generally greater than those in the Oratia and Opanuku streams. This is due to the large proportion of housing in the Waikumete catchment, the large number of stormwater systems and wastewater overflows, and much less riparian (stream bank) vegetation in the Waikumete Stream.

The amount of impervious (water-resistant/solid) vegetation already present is a powerful pressure indicator along with other variables, and provides a quick gauge of the quality of the water/ sediment.

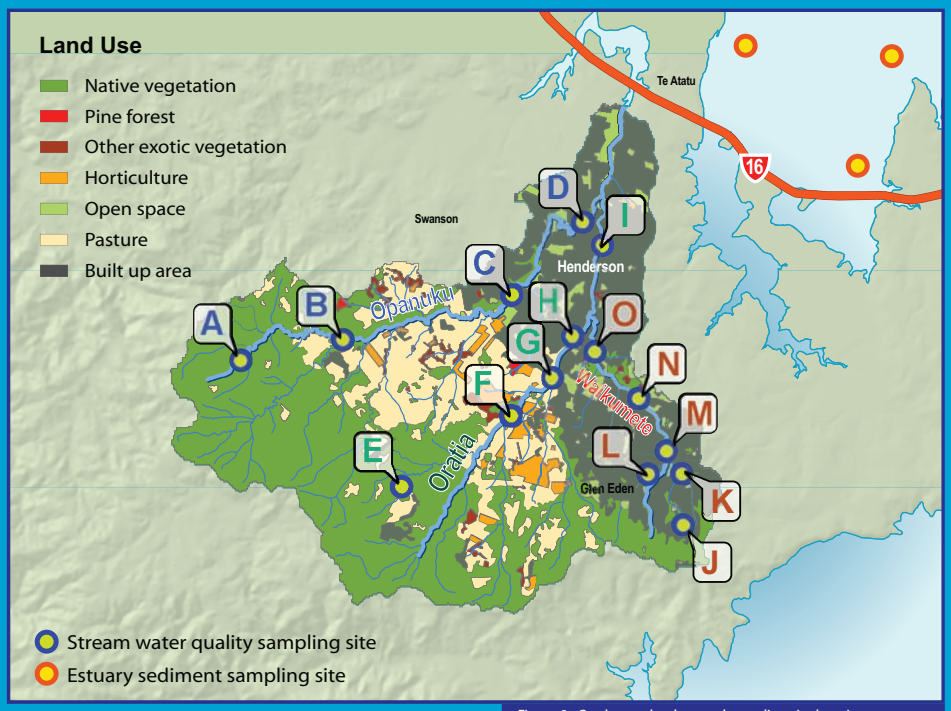


Figure 2 Catchment landuse and sampling site locations

Site	Land Use	River	Area (Ha)	Impervious Area (%)	Wastewater Overflows	Stormwater Outlets	Traffic (km)	Riparian width < 10m (%)
A	Native reference	Opanuku	365	2	0	7	8,000	0
B	Pastoral	Opanuku	1675	4	0	29	54,000	37
C	Peri-urban	Opanuku	2182	5	1	42	91,000	47
D	Urban	Opanuku	2556	10	10	84	208,000	46
E	Native reference	Oratia	72	3	0	0	13,000	11
F	Pastoral	Oratia	440	3	0	4	16,000	34
G	Peri-urban	Oratia	1629	4	1	14	88,000	47
H	Urban	Oratia	1681	5	3	23	110,000	47
I	Urban	Oratia	2850	17	67	217	446,000	53
J	Native (low density housing)	Waikumete	14	13	2	1	3,000	100
K	Urban (bush)	Waikumete	96	27	3	10	21,000	85
L	Urban (bush)	Waikumete	86	27	3	11	13,000	83
M	Urban	Waikumete	392	27	16	60	92,000	72
N	Urban	Waikumete	543	30	40	91	166,000	71
O	Urban	Waikumete	888	32	54	145	253,000	74

Ecological Monitoring

Using invertebrates as indicators of water quality

Invertebrates are small organisms without backbones that live in streams. They are commonly used as indicators of water and habitat quality. Different species show different sensitivity to pollution and changing stream conditions. Mayflies, stoneflies (see left) and caddis-flies are intolerant of poor quality water so the absence of these species tells us when the stream water is of poor quality. On the other hand, several stream invertebrate species thrive in poor habitat conditions and degraded water quality. These species include snails, midges and worms and they often occur in large numbers at degraded sites.

Each invertebrate is given a score between 1 and 10 based on their known tolerance to pollution. Biologists use this to calculate an index, the 'Macro-invertebrate Community Index' which can be ranked against water quality conditions. High MCI scores (over 120) indicate very good water quality, while MCI scores below 80 indicate probable severe pollution.

MCI values

The number of invertebrate types found within streams of the Twin Streams sites was high compared with other Auckland City urban streams. MCI scores were generally higher at upstream sites and indicative of healthy streams. The best water and habitat quality was at the upper Oratia site (Site E). The Waikumete Stream system had the poorest overall ecological quality.

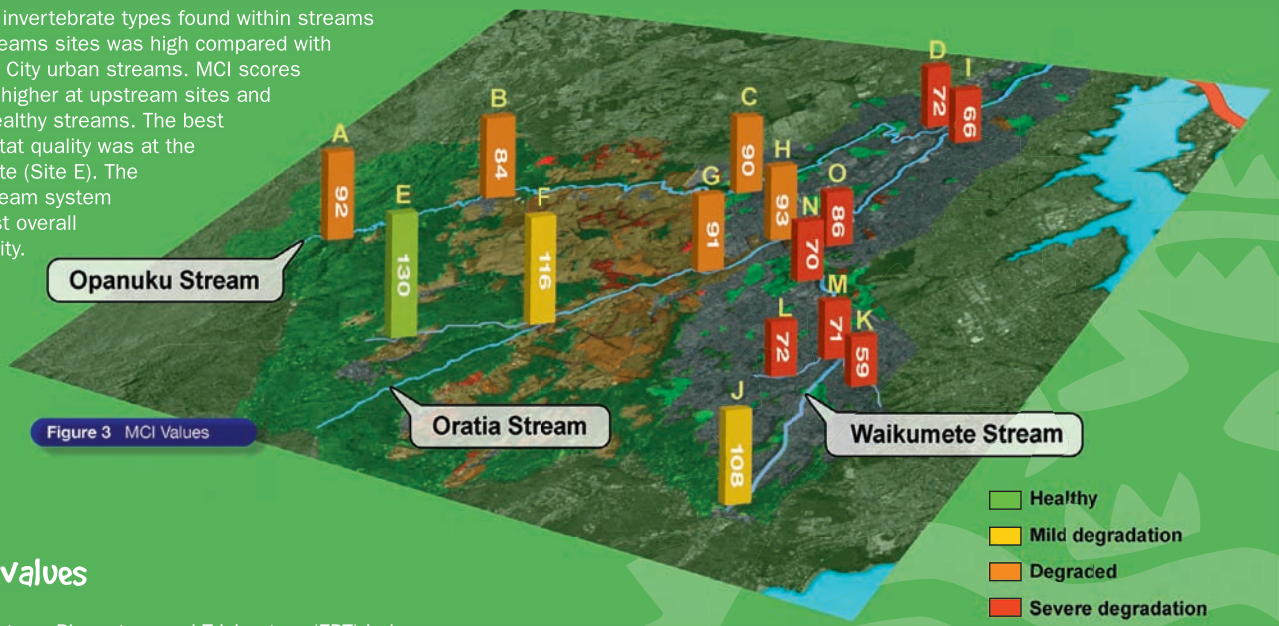


Figure 3 MCI Values

EPT taxa values

The Ephemeroptera, Plecoptera and Trichoptera (EPT) index is based on a total count of the number of sensitive mayfly, stonefly and caddisfly5 taxa present at each site. The EPT scores generally give a good indication of the health of a stream. High EPT scores suggest high water and/or habitat quality, whilst low scores typically indicate low water and/or habitat quality.

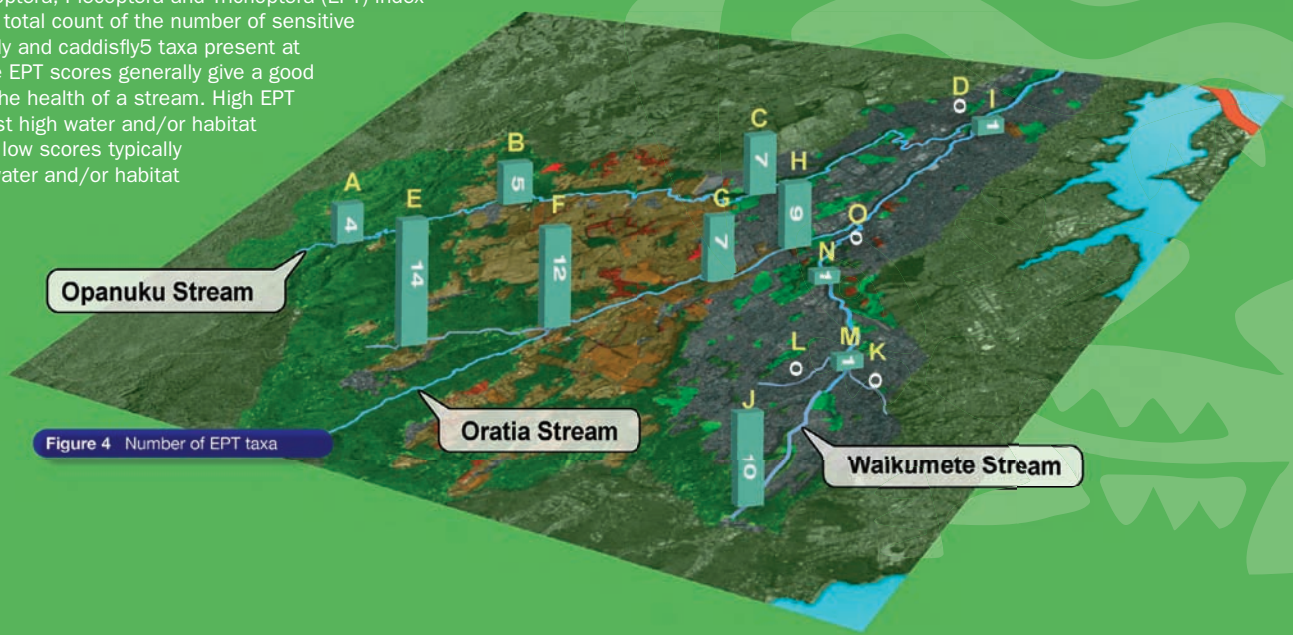


Figure 4 Number of EPT taxa

Relationship between pressure & ecology indicators

The relationship between the pressure indicators and ecology indicators is shown in Figure 5. MCI values in Project Twin Streams fall rapidly as imperviousness increases; At 10% imperviousness within the catchment, most sites indicate probable severe pollution.

Figure 5 Relationship of MCI and imperviousness

Water Quality Standards

Changes in water quality can affect human use (for example for drinking or swimming in) or for organisms to live in. Scientists have worked out limits or thresholds for each water chemical, usually with a safety margin, which means that when that limit is reached, the water may no longer be safe to use.

These limits or thresholds are called standards and we monitor water quality to see whether the quality of the stream water is within a set standard or has breached a standard. In New Zealand there are several standards that have been adopted. For Project Twin Streams monitoring we have generally adopted the 'Australian and New Zealand Conservation Council Water Quality Guidelines (developed in 2000), commonly referred to as ANZECC.


Kokopu


Redfin


Torrentfish

Ecological Monitoring

Fish

New Zealand has some 37 species of fish occurring in our rivers, streams and lakes. The diversity of fish within Project Twin Streams is good compared to other streams and rivers in Auckland. Native fish species dominate the fish fauna with only one introduced species (mosquito fish) recorded in large numbers from the Waikumete Stream. Longfin and shortfin eel, banded kokopu, redfin and common bullies as well as inanga have also been recorded in Project Twin Streams.

Water Quality

Monitoring the chemical quality of water gives us information on how clean the water is for humans to use or for organisms to live in. The results of water quality monitoring are compared with water quality standards.

Water Quality Standards

Overall, the Opanuku and Oratia Streams have higher water quality than the Waikumete Stream. The Opanuku and Oratia Streams have lower levels of dissolved zinc, nitrate and ammonia, and higher clarity (lower turbidity).

Bacterial quality was best in the Opanuku, while the Oratia and Waikumete streams were of a poorer quality (in their urban and peri-urban reaches). The poorer water quality in the Waikumete Stream catchment occurs because of the greater environmental pressures within the catchment including the large proportion of housing in the catchment, the large number of stormwater systems and wastewater overflows, and much less riparian (stream bank) vegetation.

Heavy Metals

Zinc concentrations in stream sediments were highest at urban sites, indicating a clear urban influence on the streams.

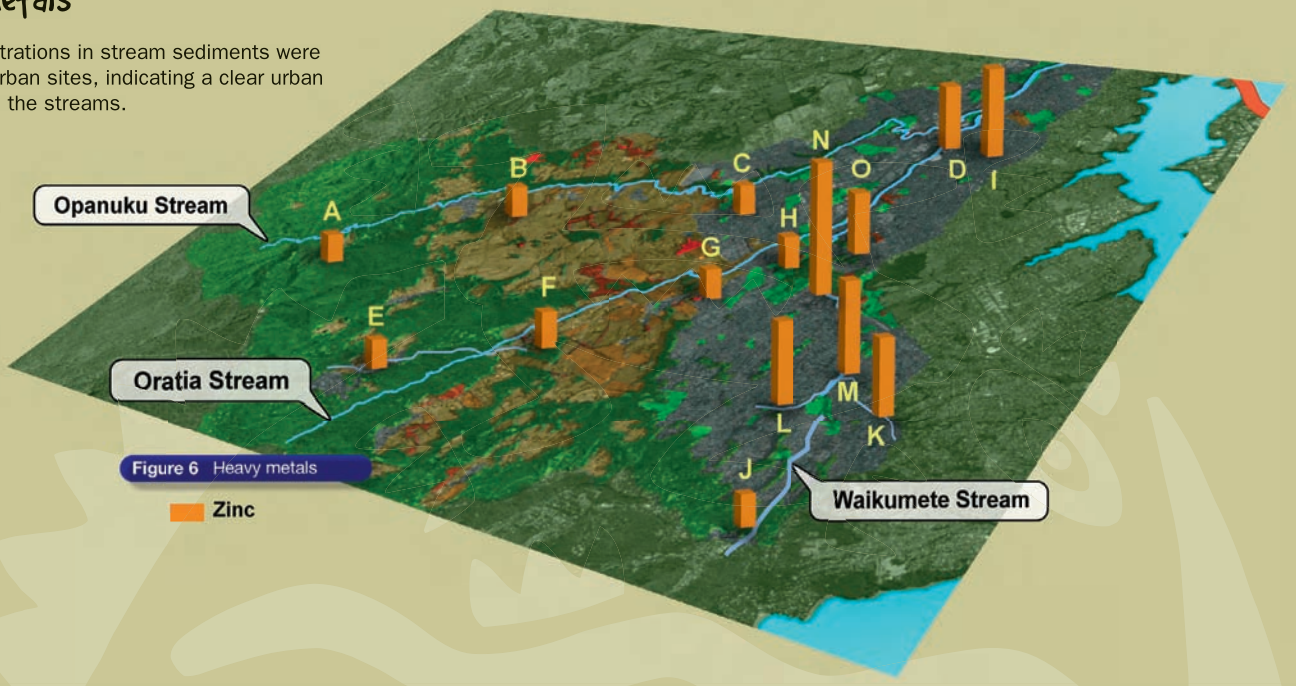


Figure 6 Heavy metals

Stream Sediment Quality

The Project Twin Streams water quality monitoring programme also examines the quality of the stream sediments. Sediment quality is important for the ecology of the stream as many organisms reside within or on the sediment and many also either feed on the sediments themselves or on algae that grows on the sediment. More importantly, the sediment can act as a 'sink' for pollutants; that is pollutants attach to the sediment and can accumulate. This means that the pollutants may stay in one place for a longer period but during floods or disturbance of the sediment, the pollutants can be re-distributed in the catchment. Detecting trends in sediment quality is a useful indicator of changes in contaminants within the catchment.

Pesticides

Pesticides used on crops and vegetation are often present in stream sediments due to land runoff and soil erosion.

DDT and dieldrin were the only organochlorine pesticides consistently detected. DDT was present above detection limits at 10 of the 15 sites.

What's happening in our streams?

In the schematic below the stream is flowing through a range of different land use types.

1. In the Waitakere Ranges the streams are well-shaded and cool with a rocky bottom and lots of habitat for fish and invertebrates.

2. Flowing downstream to the foreground, healthy riparian vegetation continues to provide a cool and shaded stream environment. Riparian vegetation provides inputs of leaves, branches and terrestrial invertebrates which are beneficial to stream ecosystems.

3. Fencing limits stock access to streams (preventing disturbance to the stream bed).

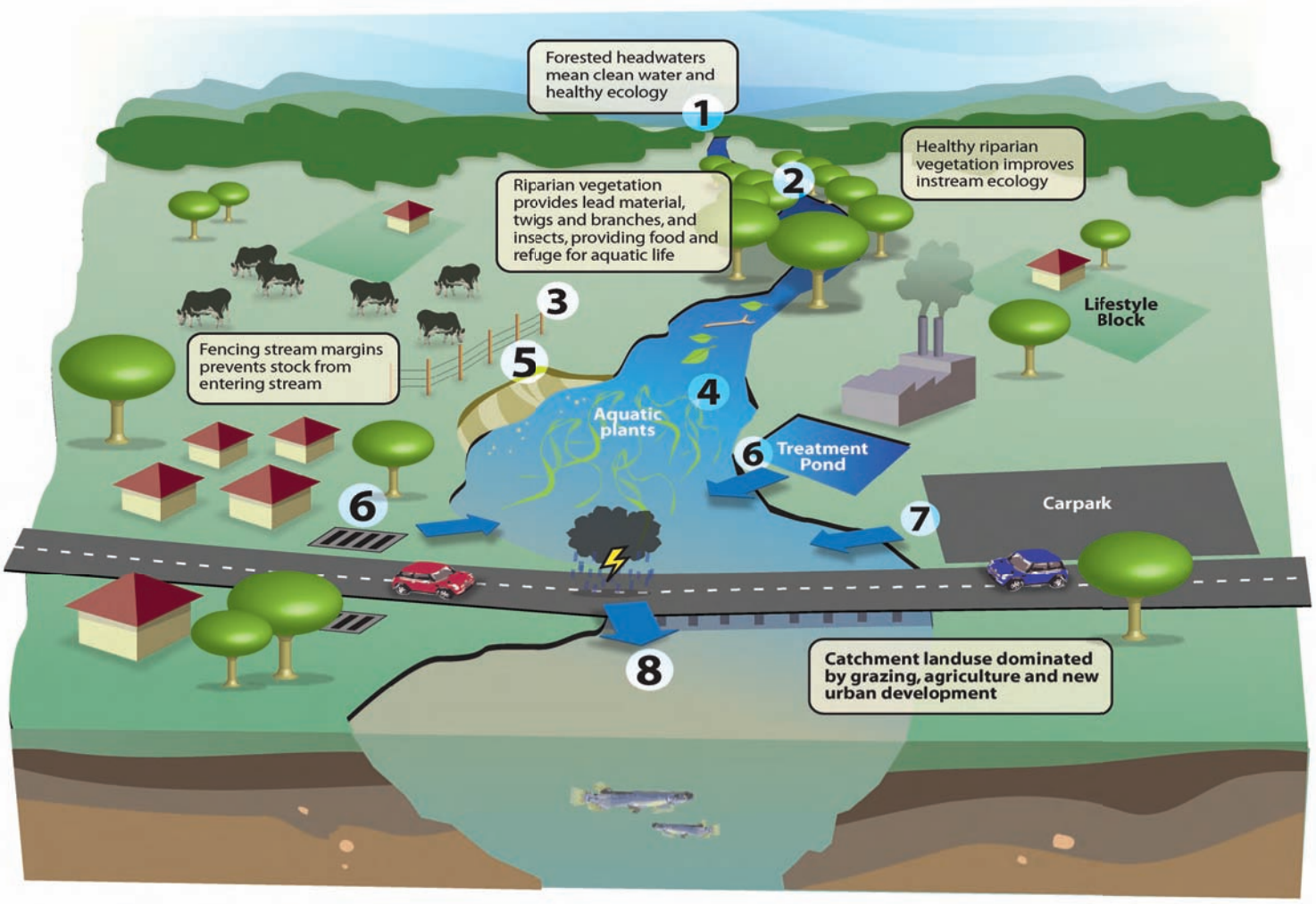
4. Where riparian vegetation has been removed within the catchment then warmer stream temperatures and increased light can lead to more aquatic plant growth which can reach nuisance levels.

5. Bank erosion results in more sediment entering the stream and a drop in clarity, which makes the waterway less favourable for swimming and other recreational use, and can impact on migrations of native fish.

6. Authorised and unauthorized discharges from industry, wastewater and stormwater contribute contaminants to the stream.

7. As urban growth continues, increases in buildings, paving, roads and concreting leads to more impervious surface which is a major influence on stream condition and water quality.

8. Stormwater is a major problem in the city; when it rains it washes over the roads and concrete, washing heavy metals, PAHs (Polycyclic Aromatic Hydrocarbons), bacteria and litter into the waterways.



Estuarine Sediment Quality

Estuarine environments are highly dynamic as a result of the tidal cycle and input from streams, the sea, and other parts of the estuary and from direct run-off from the land.

The quality of estuaries is measured by the quality of the sediments found there. Estuarine sediments from the upper reaches of Henderson Creek estuary were sampled. Zinc levels were higher (and more variable) in the channel bed sediments than in the bank sediments.

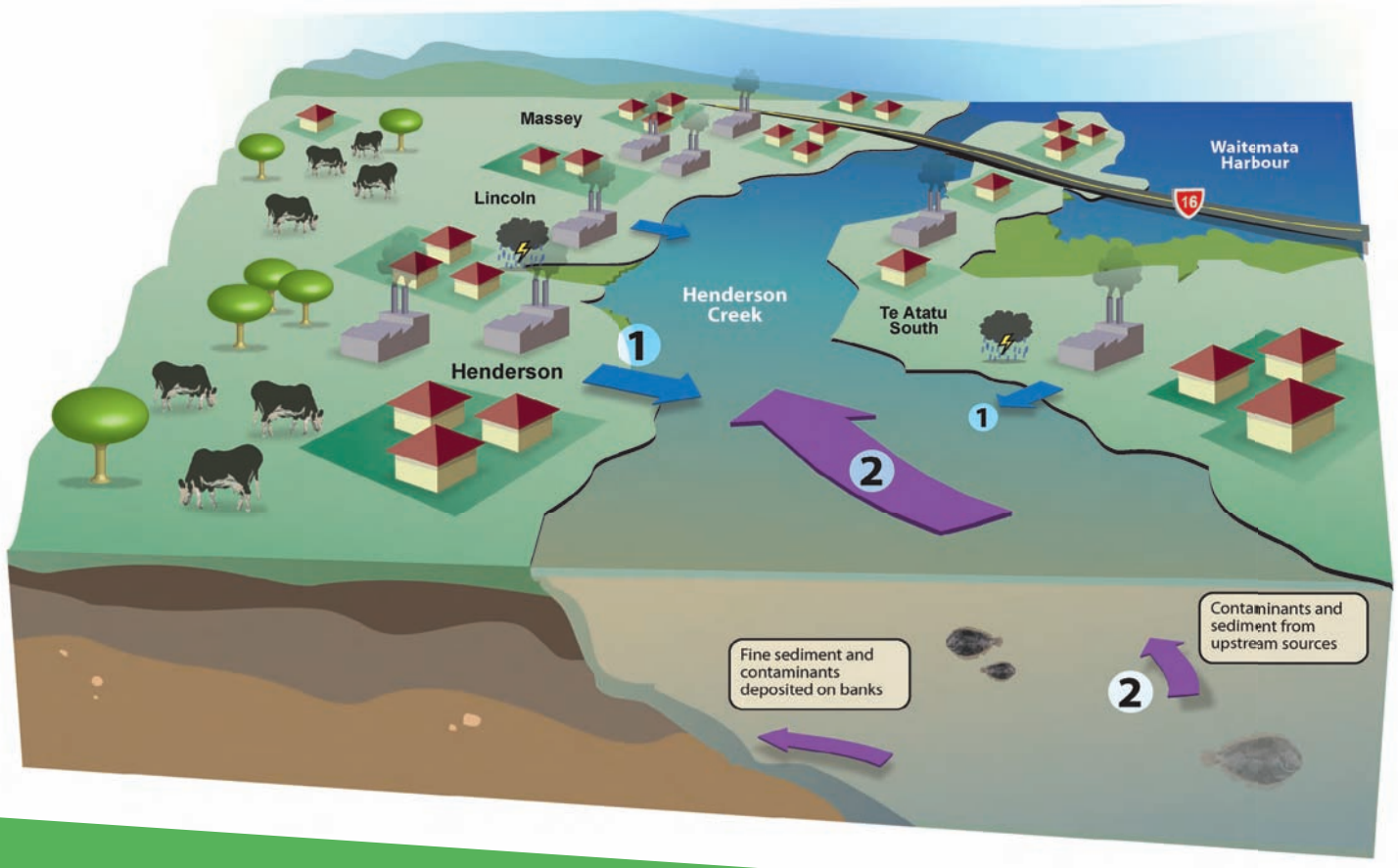
Estuarine Sediments – as indicators of ecosystem health

This schematic shows the estuarine-tidal lower end of the Twin Streams catchment.

1. Stormwater from the built up areas of Henderson, Lincoln and Te Atatu South introduces heavy metals, PAHs, sediment, bacteria and litter to the estuary.

2. Inputs of stormwater, runoff from the land and industrial and wastewater discharges flow down the rivers into the estuary.

The estuarine sediments become the 'sink' for all of these contaminants and they can be 'locked-up' for long periods of time. However, the natural ebb and flow of the tide, as well as periodic flooding means that the bottom sediments are regularly re-distributed and the contaminants are once again available as contaminants to aquatic life. Water quality of the estuaries is typically poor with high turbidity and nutrient levels.



Further Reading

Several reports on Project Twin Streams have been compiled. The results shown here have been drawn from the following:

Project Twin Streams Catchment Monitoring: Pressures and State of the Environment: Synthesis. Prepared for EcoWater Ltd. by EnviroVentures & Associates Ltd., Diffuse Sources Ltd. and Kingett Mitchell Ltd.

Project Twin Streams Catchment Monitoring: Ecological Monitoring Report. Prepared for EcoWater Ltd. by Kingett Mitchell Ltd., in association with EnviroVentures & Associates Ltd. And Diffuse Sources Ltd.

Project Twin Streams Catchment Monitoring: Sediment Quality Monitoring Report. Prepared for EcoWater Ltd. by Diffuse Sources Ltd. In association with EnviroVentures & Associates Ltd. And Kingett Mitchell Ltd. Project Twin Streams Catchment Monitoring:

Project Twin Streams Catchment Monitoring: Water Quality Monitoring Report. Prepared for EcoWater Ltd. by Diffuse Sources Ltd. in association with EnviroVentures & Associates Ltd. And Kingett Mitchell Ltd.