

Report on Studies Completed for River Guardians 2007

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Executive Summary

This report summarises research undertaken for the River Guardians project. The report provides background information, research summaries and priorities for progressing the River Guardians project. The key points in this report are:

- Christchurch city has two major catchments, the Avon/Ōtakaro river catchment and the Heathcote/Opawaho river catchment. Both catchments are significantly degraded.
- The quality of the Avon/Otakaro and Heathcote/Opawaho waterways are of significance concern to tangata whenua.
- A River Guardians project has been launched by Environment Canterbury to enhance the quality of Christchurch's urban waterways.
- The physical science research conducted for the River Guardians project in 2007 concentrated on water quality. Further research on the ecological status of the waterways is warranted.
- The literature on water quality in Christchurch urban waterways is incomplete. In order to better understand water quality problems, further studies of: sedimentation under storm conditions, sedimentation related to different land uses, the effects of nutrient levels on Christchurch aquatic ecosystems, sources and effects of heavy metal pollutants, sources and levels of selected microbial pollutants (E. coli) are particularly important.
- Water quality in both the Avon/Otakaro and Heathcote/Opawaho catchments is of low quality. Sedimentation, nutrient enrichment, toxic pollution and faecal contamination are all serious problems.
- Specific tributaries are particularly degraded (Haytons Drain, Addington Drain, Curletts Road Drain, Dudley Creek, Horseshoe Lake) and attention focused on these waterways could affect water quality in the mainstems.
- Improvement of water quality is achievable through coordinated management efforts in conjunction with further scientific investigation.
- Christchurch residents value healthy waterways and look primarily to Christchurch City Council for leadership in managing Christchurch urban waterways.
- Christchurch residents are generally poorly informed about the waterway system in the city. In addition, they have a poor knowledge of stormwater and its effects on waterways.
- Christchurch residents are generally willing to take some actions to improve waterway health but only a minority are willing to engage in communal waterway enhancement projects.
- There are a variety of approaches to engaging the public in urban waterway enhancement programmes, including education campaigns, behaviour change campaigns and direct action activities. It appears that very few of these campaigns and activities have been evaluated and local knowledge may be the best guide for future programmes. Evaluation should be a component of any intervention programme.
- The River Guardians programme needs a long-term focus, beginning with an action plan spanning the current term of the LTCCP.
- Coordination of effort with, and cooperation from, Christchurch City Council is a key to success for the River Guardians programme.
- A combination of further scientific investigation, targeted use of existing management tools, development of enhanced or additional management tools, and public education, behaviour change and waterway enhancement activities are recommended to achieve the goals of the River Guardians programme.

Terminology

Christchurch city has more than 400 named waterways. Some waterways occur in part as streams, in part as boxed drains, in part as piped drains. The term 'drain' is used to denote a means of carrying away surplus or unwanted water and other materials such as sewerage overflows. In some urban areas, including Christchurch, rivers and streams are used as drains, at least occasionally (such as during storm events). Waterway health necessitates consideration of the entire waterway and so, in this report drains are considered an integral part of the waterway system as a whole.

Table of contents

Executive Summary	i
Terminology	ii
1 Christchurch Urban Waterways: Background	1
2 River Guardians Programme	2
2.1 Background	2
2.2 Objectives of ECan’s River Guardians Programme.....	2
3 Water Quality Data Analysis	4
3.1 Overview	4
3.2 Main Results.....	4
3.2.1 Sedimentation.....	4
3.2.2 Nutrients	5
3.2.3 Toxic pollutants.....	5
3.2.4 Microbial contamination.....	6
3.3 Recommendations arising from data analysis results.....	6
3.3.1 Sedimentation.....	6
3.3.2 Nutrients	6
3.3.3 Toxic pollutants.....	7
3.3.4 Microbial contamination.....	7
4 Water Quality Literature	8
4.1 Overview	8
4.2 Results	8
4.2.1 Sedimentation.....	8
4.2.2 Nutrients	8
4.2.3 Pollutants and toxins	8
4.2.4 Faecal contamination	9
4.2.5 Litter.....	9
4.3 Recommendations	9
5 Public Perceptions of Christchurch Urban Waterways	10
5.1 Overview	10
5.2 Summary of Results.....	10
5.2.1 Awareness and Use of Rivers and Streams in Christchurch	10
5.2.2 Health of the Rivers and Streams in Christchurch	11
5.2.3 Understanding of the River and Stormwater System	11
5.2.4 Improving the Water Quality of the Rivers and Streams in Christchurch	12
5.2.5 Comparison with National Data.....	12
6 Public education, behaviour change, participation	14
6.1 Overview	14

6.2	Findings	14
6.3	Broad Recommendations.....	16
6.3.1	Summary of broad recommendations for raising awareness.....	16
6.3.2	Summary of broad recommendations for increasing knowledge	16
6.3.3	Summary of broad recommendations for changing behaviour	16
6.3.4	Summary of broad recommendations for achieving community participation	17
6.3.5	Specific Methods	18
7	State of the Takiwa. Te Āhuetanga o Te Ihutai. Cultural Health Assessment of the Avon Heathcote Estuary and its catchment..	19
7.1	Overview	19
8	Discussion and Conclusions	20
9	References/Sources.....	22

1 Christchurch Urban Waterways: Background

Christchurch has a population of approximately 360,000 spread over an area of about 450km². The city is divided into two main catchment areas, the Avon/Ōtakaro river catchment and the Heathcote/Opawaho river catchment. The Avon/Ōtakaro catchment is predominantly residential with some industry and covers an area of approximately 85km². The Heathcote/Opawaho catchment covers an area of approximately 100km² and is about 50% developed. Most of the developed area is medium density residential land use, with the remainder being industrial. Whereas the Avon/Ōtakaro catchment is generally flat the Heathcote/Opawaho is about 30% rural hill land use (URS Report, p1). The research work commissioned by Environment Canterbury for the River Guardians project, and summarised in this report, was concerned only with these two waterways. A wider focus was beyond the resources of the River Guardians project at this time.

The Avon/Ōtakaro and Heathcote/Opawaho rivers both flow to the Avon-Heathcote Estuary/Ihutai. They share similar characteristics, peculiar to the local topography: “[b]oth rivers are primarily spring-fed, slow flowing and meandering and have a number of tributaries that include both natural streams and man-made drains” (PDP report, p4). Both rivers receive stormwater drainage from several sources. This stormwater contains many contaminants including sediment, heavy metals, nutrients, organic compounds and pathogens (URS Report).

Te Ihutai is an area of immense cultural and historical importance to tangata whenua within the Christchurch and wider Canterbury area. The estuary not only provided vital access to waterways stretching from Te Waihora (Lake Ellesmere) to the Kowai River, and to the fishing grounds of Te Tai o Maha-a-nui (Pegasus Bay), but was a place of significant settlement and food gathering for Waitaha, Ngāti Mamoe and Ngāi Tahu for over 600 years. The food and resources taken from the estuary were also part of an important trade and social network between hapū and whānau throughout Te Waipounamu (the South Island) (Pauling et al, 2007).

The drainage of the original swamplands and development of urban Christchurch has degraded the both catchments and adversely affected the way tangata whenua value the area. Sedimentation, clearing of native vegetation, local extinction of fauna and pollution have contributed not only to ecological damage but to cultural identity and wellbeing for tangata whenua (Pauling, 2007).

Christchurch’s waterways, in particular the Avon/Otakaro, are strong features of the city’s municipal and commercial identity. Exotic tree species, mown grass and waterfowl are among the icons of ‘the Garden City’.

2 River Guardians Programme

2.1 Background

Public reactions to the diesel spill into the upper Heathcote River on 11 February 2005 included demands for greater community involvement in caring for the city's rivers, in line with Christchurch City Council's (CCC) historic River Warden's programme. Environment Canterbury (ECan), with assistance from CCC staff, began working with representatives of the community to develop a 'river guardian' project. The Avon-Heathcote Estuary Ihtai Trust (AHEIT) submitted an initial application to the Ministry for the Environment's Sustainable Management Fund (SMF) for support of what had become the River Guardian (RG) project. The AHEIT were asked to submit to the second round of SMF but felt they did not have the resources to carry this out so ECan submitted the full RG application in their place. This RG project was based on the discussions ECan staff had with CCC and Waimakiriri District Council staff and the community representatives. This application focused on community action on the ground. In the same time frame the RG project was put into ECan's LTCCP and gained support from ECan councillors. The application to SMF was unsuccessful. However, an amended RG project was still viable with ECan support.

The original objectives of the River Guardians project were -
To improve the ecological health of urban waterways by:

- Increasing the level and effectiveness of adult urban community involvement in management and care of their urban waterways.
- Increasing adult community knowledge, environmental awareness and responsibility with regards to the effect of their individual and cumulative actions on urban waterways.
- More effective and proactive agency management of urban waterways through increased co-ordination

At the conclusion of ECan's LTCCP 2006-2016 process it became apparent that ECan councillors' expectations of the River Guardians project were that it would improve the health of urban rivers, similar to the outcomes of the successful rural Living Streams programme.

As a result of discussions with CCC and ECan staff on aspects of the existing outputs and as a result of reviewing both the unsuccessful SMF application and ECan councillors' expectations, Resource Care staff decided that the plan of action in 2006/7 needed more research than action.

Instead of launching into a community action programme as indicated in the SMF application, the RG project was revised so that there was more emphasis in the first years on both physical science and social research to ensure a higher probability of future community actions being effective. Achievable and measurable outcomes became key principles of the project's development.

2.2 Objectives of ECan's River Guardians Programme

Based on discussions with other ECan staff and CCC staff in 2006 and 2007, Resource Care staff reconsidered the best way to approach the River Guardian programme and came to the conclusion that what was most needed was an emphasis on the ecological health of urban waterways. Following this conclusion, Resource Care staff formed the view that an initial requirement was for high-quality baseline information about:

- Water quality
- River contaminants
- Contemporary approaches to community involvement in stream health
- Public perceptions of waterways.

The outputs of this background research, then, are:

- A report on the state of the urban waterways (water quality data analysis);
- A report on the state of the research literature on contaminants in the urban waterways;
- A report on the urban community's perceptions of urban waterways and their potential involvement;
- A report on the state of the literature on public engagement in waterway programmes and the effectiveness of those programmes.

The water quality data analysis was undertaken by Paddle Delamore Partners (Christchurch). URS Ltd (Auckland and Christchurch) completed the literature review on urban water contaminants. Opinions Marketing (Christchurch) undertook the market survey on perceptions of waterways. Taylor Baines and Associates (Christchurch) completed a literature review on public engagement in waterway programmes.

Sections 3 – 6 of this report summarise the findings of the research outlined above. Section 7 provides an overview of another relevant study ('The State of the Takiwa' report) completed independently but at the same time as the River Guardians commissioned research. The final section draws conclusions from all the research summaries and provides a basis for the River Guardians Programme Strategy (see attached).

3 Water Quality Data Analysis

3.1 Overview

Pattle Delamore Partners Ltd (PDP) was engaged by Environment Canterbury to undertake a comprehensive analysis and interpretation of water quality data held by the Christchurch City Council (CCC) for the Avon and Heathcote rivers. Water quality data has been collected by the CCC from numerous sites on city waterways for many years and the length of the data set now available enables rigorous statistical analysis for the determination of trends. The objectives of the study were to:

- identify temporal trends in water quality at each site on each river;
- identify spatial trends longitudinally on each river;
- establish the current state of each waterway by comparing data with relevant guidelines;
- compare the water quality of the two rivers;
- use existing available information to discuss possible causal factors for water quality issues at particular sites and for significant trends identified.

For the statistical analysis of temporal trends a 15-year period of data was used, from January 1992 to December 2006. To assess the current state of the waterways the quarterly data from January 2002 to December 2006 was analysed.

3.2 Main Results

The following discussion outlines the main results that were found in the water quality data analysis study. The sections summarise the major issues of concern for the urban rivers with respect to different types of contaminants. It is important to recognise the difference between temporal trends and the current state of the rivers, as a decrease in a contaminant over time may represent a positive trend but the contaminant concentration may still exceed guidelines for ecological health and/or aesthetic quality. It is also important to understand that while water quality guidelines are useful for assessing the suitability of water for various uses and for determining the state of water quality in terms of concentrations of contaminants that may impact on ecosystem health, the guideline values should be used with care. When interpreting compliance with guidelines and the implications of exceedences it is important to understand the basis of the guideline value and how it is intended to be applied [For information on this point, please refer to the full PDP report.]

3.2.1 Sedimentation

Sedimentation and clarity in the Avon and Heathcote rivers has been assessed using suspended solids concentrations. Sedimentation discolours water, destroys habitat for species that live in the bottom of streams such as insect larvae and small fish, effects visibility for fish for feeding, and can clog gills and abrade scales and gills thereby directly affecting fish health. Water clarity is also important for aesthetic and safety aspects of the recreational use of water bodies.

Suspended solids concentrations have shown an increase over the past 15 years at some of the Avon catchment sites and a decrease at some of the Heathcote catchment sites. Overall, however, the majority of sites have experienced concentrations that exceed the aesthetic guideline value of 10 mg/L and a large number of sites, particularly in the

Heathcote catchment, showed exceedences of the higher 25 mg/L guideline for behavioural impairment in fish. On the mainstem of the Heathcote River suspended solids concentrations were particularly high at the Motorway Bridge site and the Ferniehurst Bridge site, reflecting inputs from the Haytons Drain and Cashmere Stream tributaries.

High levels of sedimentation are widely reported for urban waterways where stormwater inputs are a major contributor. The high suspended solids concentrations in the Heathcote catchment can be attributed to stormwater inputs from the steep and easily erodible soils of the Port Hills, as well as a lack of appropriate vegetation for ecological values and bank protection for the hill streams in the catchment and lowland drains. Construction activities also represent a potentially significant source of sediment if poorly managed. Recent ecological studies have concluded that a decline in clean gravel substrates over the past 10 – 15 years in both the Avon and Heathcote rivers has been a major factor in a decrease in trout spawning habitat and an overall decline in invertebrate health in the rivers.

3.2.2 Nutrients

Nitrogen and phosphorus are the primary nutrients that influence plant and algal growth in waterways. Nitrate-nitrite nitrogen and dissolved reactive phosphorus are the main forms of nitrogen and phosphorus in waters that are immediately available to plants and, in combination with other factors, high concentrations of these determinands can result in the proliferation of aquatic plants or algae. The ratio of nitrogen to phosphorus concentrations in waterways provides an indication of which nutrient is likely to limit algal growth and in Canterbury lowland streams phosphorus tends to be the limiting nutrient.

The strongest trend over time found in the data analysis study was a decrease in nitrate-nitrite concentrations, which was seen at all Avon catchment sites as well as some Heathcote catchment sites. The reason for the trend is not clear but it is consistent with a similar decrease in groundwater nitrate concentrations detected over a similar period in the shallow aquifers in the Christchurch-West Melton area. Despite the decrease, nitrate-nitrite concentrations remain high and almost all sites had median concentrations above the trigger value at which risk of adverse ecosystem effects due to nutrient enrichment may occur.

In contrast, a number of sites in the Avon catchment and the two sites on Cashmere Stream have shown an increase in dissolved reactive phosphorus over the last 15 years. As phosphorus is the limiting nutrient in these waterways this trend for increasing concentrations is of concern. Elevated dissolved reactive phosphorus concentrations at sites in both the Avon and Heathcote catchments can be linked to a range of potential sources, including industrial activities in the Haytons Drain catchment and market gardening/agricultural activities in the Dudley Creek and Horseshoe Lake catchments. Measures to reduce the inputs of phosphorus to these tributaries are likely to result in improvements in phosphorus concentrations in the main rivers.

3.2.3 Toxic pollutants

The main toxic pollutants that are measured in the urban waterways are ammonia-nitrogen and heavy metals. Ammonia-nitrogen is a minor component of plant-available nitrogen but the main concern with ammonia concentrations in waterways are its toxic effects on aquatic ecosystems, which occur at concentrations above approximately 0.9 mg/L. Heavy metals can be toxic to plants and animal life even at low concentrations.

Particularly high concentrations of ammonia-nitrogen in exceedence of the toxicity trigger value were observed at the Haytons Drain sites and this may be due to inputs from industrial activities in the catchment. The sites on the Heathcote River downstream of the confluence with Haytons Drain are strongly influenced by this input and also by high concentrations in Curletts Road Drain. In the Avon catchment, Addington Drain showed exceedences of the

toxicity trigger value for ammonia-nitrogen, which may be a factor in fish kills that have been reported in this waterway.

The data for heavy metals was restricted to the Haytons Drain and Curletts Road Drain sites and showed that zinc and copper were the metals that were most frequently detected and most often exceeded the relevant guideline values for toxicity.

3.2.4 Microbial contamination

Microbial quality has been measured in the urban waterways using both faecal coliform and *E. coli* concentrations, however *E. coli* is the currently preferred means of monitoring human health risk as it is a more specific indicator of recent faecal contamination. Microbial contamination is an issue for contact recreation in both the Avon and Heathcote rivers.

E. coli concentrations have reduced at a number of sites on both the Avon and Heathcote rivers over the last 15 years but remain high, with exceedences of the 550 cfu/100mL “action mode” guideline for contact recreation being widespread and frequent. A large number of sites in the Heathcote catchment, as well as the Dudley Creek and Horseshoe Lake sites in the Avon catchment, had over half of the results in exceedence of this guideline. The sites that are nearest to areas that are likely to be used for recreational activities, such as rowing and kayaking, are the tidal sites. These sites had the lowest overall distributions of *E. coli* concentrations but still experienced 3 or 4 exceedences of the guideline value within the data period. The relationship between *E. coli* concentrations and river flow indicates that sources of microbial contamination are likely to be varied, with some input from in-situ sources such as waterfowl and further input from stormwater flows.

3.3 Recommendations arising from data analysis results

3.3.1 Sedimentation

Suspended sediment concentrations and associated sedimentation can be reduced by implementing land management practices that reduce sediment sources by minimising exposed surfaces in catchments and particularly adjacent to waterways. Specific measures include:

- Banks stabilisation and increased ground cover such as native vegetation and/or long grass.
- Sediment control during construction – implementation of the Erosion and Sediment control guideline.
- Stream cleaning and maintenance works – careful weed and sediment removal.

3.3.2 Nutrients

Nutrient inputs can be related to both point source and diffuse source pollution and the control of nutrient sources to waterways is therefore complex. Specific measures include:

- Raising individual awareness and care with use of fertilizers, detergents etc, in domestic and market gardening sectors.
- Ongoing management of fertiliser and animal effluent in Canterbury rural sector.
- Control (eg. through planting of appropriate species) of Banks Peninsula soils because they are P-rich.

3.3.3 Toxic pollutants

It is important that pollution prevention measures are implemented at industrial sites to prevent the introduction of toxic pollutants to urban waterways. Domestic activities also have the potential to contribute toxic pollutants via the stormwater system and householders need to be aware of the impact of actions such as disposal of paints and chemicals into stormwater drains. Specific measures include:

- Raising individual awareness and care with use of domestic chemicals.
- Maintaining and improving industry controls on discharges from industrial sites, in conjunction with ECan's Pollution Prevention Officers.
- Ensuring adequate stormwater treatment systems are in place.
- Investigating the very poor quality of some drains.

3.3.4 Microbial contamination

E. coli contamination arises from faecal matter entering the waterways. Specific measures to reduce this contamination include:

- Encouraging dog owners to be responsible with dog droppings, especially near waterways
- Habitat modifications to discourage mass groupings of water fowl
- Reduction of sewage overflow events
- Investigation of better cleaning of roads and stormwater sumps and drains)

4 Water Quality Literature

4.1 Overview

URS New Zealand Ltd (URS) was engaged to conduct a review of local, national and international literature on urban surface water quality, with a particular emphasis on Canterbury urban water quality. The main objectives of the study were to identify and review literature that had information on the following:

- likely sources of contaminants in Canterbury urban rivers and streams;
- the mechanisms and extent of contaminant loads and transport;
- the comparative background concentrations of contaminants in Christchurch urban rivers with rural and non-developed systems elsewhere in New Zealand and internationally; and
- the current known effects of these contaminants on the receiving environment.

This literature review found that, in general, information was available on all contaminants to a varying degree at local, national and international level. However, methodologies used, location, timescales and extent of studies meant that few were directly comparable. Key contaminants of concern in the Christchurch area are confirmed to be: sediments, heavy metals, nutrients, organic compounds and pathogens. This is consistent with elsewhere in New Zealand and overseas.

4.2 Results

4.2.1 Sedimentation

Literature found for sedimentation that had direct relevance to the Avon/Ōtakaro and Heathcote/Opawaho Rivers was extremely limited.

“Since the Avon-Heathcote Estuary/Ihutai is the final sink for much of the sediment derived from the Avon/Ōtakaro and Heathcote/Opawaho Rivers a lot of literature and studies have focused on the effects of sediment on this waterbody rather than the rivers themselves. The relationship between land use and contaminant loads and concentrations are poorly researched in the Christchurch area. Further studies into the determination of concentrations and loadings for catchment type as Auckland Regional Council (ARC) (2005) has conducted would be useful” (URS Report p9).

4.2.2 Nutrients

Haytons Drain (possibly), Dudley Creek and Horseshoe Lake are high in ammonical nitrogen and dissolved reactive phosphorous (DRP) and deserve further attention. The review indicates a need for more study on effects of nutrient levels on aquatic ecosystems.

4.2.3 Pollutants and toxins

There is extensive research on PAHs in Christchurch, less so for other organic compounds such as organochlorine compounds which may result from herbicides and pesticides usage. The effect of roof types on metal loads and concentrations (and to a lesser extent other contaminants) in Christchurch were not available.

Literature on heavy metals in the Avon/Ōtakaro and Heathcote/Opawaho rivers is extremely limited, but some mention is made of their tributaries. Further research is needed to confirm the levels heavy metal contamination, identify sources and potential remedial measures.

4.2.4 Faecal contamination

“An extremely limited amount of data was found regarding coliform levels throughout the Avon/Ōtakaro and Heathcote/Opawaho Rivers and Estuary” (URS report, p34). Further research should be undertaken to identify the [levels and] sources of faecal contamination of the waterways, and potential mitigation measure, particularly in the Heathcote/Opawaho river. [The PDP report, summarised in section 3 of this report, now helps to fill this gap in the scientific literature.]

4.2.5 Litter

“No studies of gross contaminant with respect to litter were found for Christchurch in the course of this literature study” (URS report, p35). [NB: CCC has undertaken some studies that consider litter in the urban waterways (the Christchurch River Environment Assessment Surveys (CREAS) studies)].

4.3 Recommendations

The literature review identified the following key gaps and areas for possible future research in the Christchurch area:

- The relationship between landuse (including construction sites) and contaminant loads and concentrations is poorly researched. Further studies in this area could be useful.
- Specific studies of contaminant levels in sediments for the Avon/Ōtakaro and Heathcote/Opawaho Rivers are needed (as per the ARC research on this topic).
- Continued research into levels of pesticides and herbicides in Christchurch waterways.
- Studies of faecal coliform contamination in surface waters, particularly during storm events, is needed.
- More studies of the effects of contamination from stormwater on macroinvertebrates, invertebrates, and vertebrate communities of Christchurch streams are needed.
- Studies are needed of the contaminant levels entering the Avon/Ōtakaro and Heathcote/Opawaho Rivers during normal conditions versus storm conditions.
- Investigation is needed to identify point sources of contamination entering the Avon/Ōtakaro and Heathcote/Opawaho Rivers and the associated contaminant levels from these.
- Investigations are needed of metals concentrations in both river catchments.

5 Public Perceptions of Christchurch Urban Waterways

5.1 Overview

Opinions Market Research, Christchurch, was contracted to conduct a survey of Christchurch residents about the city's urban waterways. The primary objectives of the research were fourfold:

- To measure residents' perceptions of the health of the rivers (do residents believe the rivers are polluted and to what extent?)
- To gauge residents' understanding of the river and stormwater system (what is stormwater? where does it come from? where does it go?)
- To measure residents' desire to be involved in any river improvement and if so, to what extent?
- To assess residents' ratings of the importance of the health of the city's rivers.

A telephone survey method was adopted. The sample was randomly selected from telephone listings in the Christchurch region. Random sampling was combined with quota sampling to ensure a representative achieved sample by age and sex (by matching those interviewed with the composition of the Christchurch region at the last published Census). Many questions in the survey were open-ended, seeking a full range of responses from respondents rather than presupposing their responses. The survey questionnaire is included in the full market survey report document.

Telephone interviews commenced on Saturday 9 June 2007. On Thursday 14 June, an article appeared in *The Press* entitled 'Christchurch rivers highly polluted'. The article focused on the level of potentially toxic chemicals in Christchurch river sediment. As this article was likely to impact on respondents that had read it, a decision was made to halt interviewing. Interviewing re-commenced on Monday 2 July and finished on Thursday 12 July. The average length of interviews was 13 minutes.

The summary below provides an overview of the market survey results. For further detail, please refer to the full report by Opinions Market Research Ltd entitled *The River Guardians Project. Perceptions among the general public*

5.2 Summary of Results

5.2.1 Awareness and Use of Rivers and Streams in Christchurch

- Most respondents (98%) had heard of the River Avon. 76% recalled the Heathcote, 10% the Wairarapa and 9% Dudley Creek. All other waterways were mentioned by 6% of respondents or less.

- Two thirds of respondents (66%) had been to the Avon, 29% to the Heathcote in the past year. All other rivers and streams had been visited by 5% or less in the past year.
- 26% of respondents had been to the Avon, and 35% had been to the Heathcote, weekly or more often. However visitors to the other rivers and streams had only visited those rivers and streams a couple of times a month or less often.
- At the Avon and the Heathcote around two thirds jogged/ walked/ cycled, and around a fifth fed the ducks. At the Avon a quarter sat/ ate/ painted or just looked.
- When asked about activities they felt they could do at the rivers and streams they visited, the majority would let their dog swim (if they have one) and would walk or paddle their feet. Few would swim or eat fish caught in the river, and even fewer would drink the water.

5.2.2 Health of the Rivers and Streams in Christchurch

- When asked what they thought lives in the rivers and streams in Christchurch, 87% of respondents mentioned fish, 67% stated ducks and 58% said eels. Around a quarter mentioned insects and plants, 18% other birds and 14% rats.
- A four-point scale was used to ask respondents how healthy they thought were the rivers and streams of Christchurch. 42% felt they were healthy (although only 2% stated very healthy), and 56% felt they were not healthy (with 9% stating not at all healthy). A definition of 'healthy' was not given; rather perceptions of healthiness were sought. This is consistent with national surveys on the same question.
- Around a third of respondents felt the rivers and streams were healthy because they looked good and/or clean and/or nice, a further 7% felt they supported wildlife and 6% felt the Council maintained them well. However a higher proportion were negative about the health of Christchurch's rivers - 51% felt the rivers were polluted, contained rubbish, stormwater and industrial or farm effluent and 18% reported they looked dirty. 14% of respondents referred to river contamination from weeds (didymo), duck and animal waste or sewerage making the water unfit for swimming or drinking and a minority (5%) commented on recent negative reports in the media.
- When asked what they felt were the causes of damage to the rivers and streams, two thirds of respondents cited rubbish and pollution. Around a quarter mentioned industrial effluent/ rubbish and 17% stated stormwater. A range of other causes were mentioned by around one in 10 respondents (including ignorance, lack of care, sewage/ effluent, chemicals (weedkillers/ fertilisers), waste from roads and boats (oil/ petrol), animal/ bird waste, weeds/ plants (didymo) and garden/ farm run off). Other causes were mentioned by 5% or less. When asked to name the main cause of damage, the pattern was similar.

5.2.3 Understanding of the River and Stormwater System

- Most respondents (68%) thought water from inside the house (shower, bath, washing machine) went to the Christchurch Wastewater Treatment Plant. A quarter thought it went into the rivers and streams or into the sea.
- Responses were similar for the roof and guttering, and driveway and yard: around half the respondents thought that the water goes to the rivers and streams, 13-18% mentioned the Christchurch Wastewater Treatment Plant, a similar proportion stated the sea and a similar proportion did not know.

- Most (70%) thought water in street gutters came from rain. A large proportion also thought it came from run off from the roads (57%) or houses and gardens (41%).
- The main polluters of the water in street gutters were said to be detergents, fertilizers and weed killers (58%), leaves (41%), litter (31%) and road waste such as oil (29%). A tenth or less mentioned animal waste or roof and house waste.
- Over half (53%) thought the water from street gutters ended up in rivers and streams, followed by the Christchurch Wastewater Treatment Plant (13%) and the sea (13%). A minority mentioned the Estuary (5%), 4% stormwater drains, and 10% did not know.
- Most were concerned a lot (45%) or a little (38%) that water from street gutters ended up in rivers and streams. A minority (16%) were not concerned.

5.2.4 Improving the Water Quality of the Rivers and Streams in Christchurch

- Nearly three quarters of respondents cited the City Council (72%) as being responsible for ensuring the water quality of rivers and streams is improved, and just over half (51%) viewed all residents as being responsible. Only a quarter placed the responsibility on Environment Canterbury. Less than a tenth mentioned various other organisations, such as the Government, water board, DoC etc.
- When asked what they thought people could do to help improve the quality of the water in rivers and streams, the majority of comments focused on using biodegradable chemicals or reducing chemical use in drains or being mindful of what goes down drains, and not washing cars at home. A quarter of comments were about not littering and around a tenth mentioned recycling, not wasting water. Just over a tenth felt education and making people responsible was an important factor.
- In response to statements about rivers and streams in Christchurch, 94% agreed that having very healthy rivers and streams was really important to them. 86% agreed that they felt positive about taking actions that will help make Christchurch rivers and streams more healthy. Fewer (69%) felt that they could do more to help with keeping the rivers and streams healthy.
- Finally, respondents were asked to state from a list, what they thought they would be willing to do to help improve water quality in rivers and streams. Most stated they would be prepared to ring an 0800 pollution hotline (84%), or talk to a friend or family about the things they can do (79%). Two thirds would participate in an activity such as planting day and just over half would talk to a neighbour about things they could do. Just under a quarter (24%) were prepared to become a member of a group to monitor the health of the waterways.

5.2.5 Comparison with National Data

- Responses to three questions in the survey are comparable with responses from a national survey conducted biennially Lincoln University researchers (Hughey et al, 2004 and 2006). These questions and the respective response rates are set out in Table 1 below.

Table 5.1 Comparison of responses to selected questions from Opinions Market Research Ltd survey (2007) and Hughey et al 2004 and 2006. (Differences in wording are indicated in parentheses.)

	Opinions Market Research 2007 % respondents	Hughey et al 2004 % respondents	Hughey et al 2006 % respondents
The quality of (rivers and lakes/streams) is ...	(rivers and streams)	(rivers and lakes)	(rivers and lakes)
Very good	(Extremely good) 4	6.5	6.0
Good	27	31.5	30.7
Adequate	36	33.1	35.8
Bad	(Poor) 27	20.6	21.4
Very bad	(Extremely poor) 3	3.0	1.4
Don't know	2	5.3	4.7
Compared with 5 years ago, the quality of water in (NZ / Christchurch) rivers and streams is ...	(Christchurch)	(NZ)	n/a
Much better	1	2.4	
Better	8	7.5	
About the same	40	44.6	
Worse	30	25.9	
Much worse	2	2.8	
Don't know	18	16.9	
The state of banks and edges is ...	(Adequate)	(Acceptable)	n/a
Extremely good	1	1.5	
Good	11	21.2	
Acceptable/Adequate	36	40.9	
Poor	43	12.1	
Extremely poor	5	1.5	
Don't know	3	22.7	

- This data suggests that, in general, Christchurch residents have similar views to all New Zealanders on the quality of waterways, water quality and the state of waterway banks and edges, however comparative statistical analysis is needed before definitive statements can be made.

6 Public education, behaviour change, participation

6.1 Overview

Taylor Baines and Associates were contracted to conduct a review of available literature on public education about urban waterways, approaches to achieving behaviour change in relation to urban waterways, and participation in urban waterway enhancement projects. Evaluation reports on projects of public involvement in waterway management were of particular interest to Environment Canterbury.

6.2 Findings

- 6.2.1 There are a number of approaches to public involvement in the management of urban rivers, waterways and estuaries. These approaches can be categorised according to their primary aim: raising public awareness, increasing public knowledge and understanding, influencing relevant attitudes and values, changing relevant behaviours or achieving community participation.
- 6.2.2 'Public involvement' in the management of urban rivers, waterways and estuaries tends to refer to two distinct aspects of human conduct. One aspect focuses on individuals or households taking responsibility for actions which have consequences for the health of rivers or estuaries. The other aspect focuses on participation by groups of individuals in collective efforts to care for the health of rivers and estuaries.
- 6.2.3 Behaviour change is arguably the goal that underpins efforts to raise public awareness, increase knowledge and understanding and influence attitudes and values. Broadly speaking, there are two schools of thought as to the role these actually play in behaviour change. The orthodox view is that awareness and knowledge influence attitudes which, in turn, lead to behaviour changes. A counter view is more instrumental in character: an understanding of what actually motivates people to behave in various ways, combined with an in-depth knowledge of the barriers that prevent or inhibit the desired behaviour forms the basis for developing an appropriate set of behaviour change tools.
- 6.2.4 Though the two positions are not mutually exclusive, especially in terms of the actual content and implementation of some programme components, they start from fundamentally different premises about behaviour change and any approach should be aware of the differences between the two.
- 6.2.5 The literature review identified two methods for achieving community participation: (1) large-scale information programmes based on education and mass-advertising, and (2) Community-Based Social Marketing (CBSM). The goal of the former is to raise awareness of the environmental issue in question and, in so doing, modify public attitudes. In contrast, the goals of CBSM are to identify and remove the *barriers* which hinder community participation or make the desired behaviour inconvenient or unaffordable, and to enhance the economic and social *benefits* of the activity, thereby encouraging participation.

- 6.2.6 Practitioners of both methods agree that to be effective in achieving worthwhile participation, campaigns must be developed with the aid of primary social research data to gain a good understanding of community values, aspirations, barriers to participation and areas of conflict and cooperation. This finding reinforces the decision by ECan's Resource Care staff to invest in a research phase at this point of the strategy development for River Guardians.
- 6.2.7 One of the more contentious issues debated in the literature review is whether the involvement of community groups actually leads to bio-physical environmental improvements. Despite the lack of empirical evidence regarding claims that community involvement actually leads to bio-physical environmental improvements, there are a number of other arguments worth considering: delivering other social benefits not directly related to environmental outcomes (e.g. building social capital); even if programmes lead to only very minor changes in behaviour, the cumulative effect of many participants can be large; simply arresting or slowing the deterioration of urban rivers and streams may be the short-term goal with positive enhancements being a long-term strategic aim.
- 6.2.8 These considerations all have an impact on how the 'success' of public involvement campaigns is defined and evaluated. Several authors recommend paying attention to both the task (e.g. improved water quality) and the process (e.g. level of engagement achieved and maintained; representativeness of those engaged; the inclusion of values and ideals) through which this takes place.
- 6.2.9 Authors recommend against copying approaches "off the shelf", arguing that outcomes are often context specific and the methods used are not always transferable across different locations and geographical scales. Location and scale have implications for the suitability of the specific measures adopted.
- 6.2.10 The time-frame over which the success of the project will be measured is another consideration. For example, attitudinal changes might best be measured in terms of long-term inter-generational shifts.
- 6.2.11 Public participation in urban river ('environmental') management takes place at the social/bio-physical environmental nexus. It is therefore relevant to see such approaches as both *environmental* and *social* in character. Many programmes fail to engage the general public because of their 'scientific' approach, while community efforts are sometimes seen by the scientific community as 'botched' and 'less useful'. The challenge is to recognise the complementary strengths and roles of various participants. Though not necessarily couched in the appropriate terms, communities often have a good day-to-day understanding of how their environment works and are in the ideal position to monitor changes or alert the relevant authorities when they identify a problem. The risk is that a lack of understanding of social values can undermine well-meaning (technocentric) campaigns around river management.
- 6.2.12 Specific results and recommendations are summarised in this report in two parts. Part One (Section 4.1) provides relatively broad recommendations as they relate to the goals of raising **public awareness**, increasing **knowledge and understanding** of urban waterway and estuary management issues, influencing **attitudes and values**, changing **behaviour** and achieving **community participation** in urban waterway and estuary management projects. Part Two (Sections 4.2 and 4.3) relates the advantages and disadvantages of specific methods and particular programmes.
- 6.2.13 Those projects considered successful (in terms of self-reported behaviour change) began with a thorough pilot or scoping stage in which a good understanding of

community values, aspirations, barriers to participation and areas of conflict and cooperation were identified.

6.2.14 Behaviour change can take a long time. However, in the long-term, successful campaigns help normalise the desired behaviour.

6.2.15 *Maintaining* participation appears to be a very real problem that might be resolved (in part) through long-term support from the organisation including good communication, funding, skills, facilitators, and other resources.

6.3 Broad Recommendations

6.3.1 Summary of broad recommendations for raising awareness

- See the project as both social and environmental and make sure the organisation implementing the programme has a good understanding of the participants' values and attitudes. This highlights the value of early exploratory qualitative research and a well-designed pilot programme.
- Frame messages effectively in terms of scale (e.g. 'think global, act local') and alter the content of messages to suit different audiences.
- Use credible sources as communicators.
- Use local examples.
- Consider using high profile, mass media (TV, etc) for broad awareness campaigns and targeted media (addressed envelope) for specific, or very localized, projects.
- Mix active (demonstrations) and passive (billboards) media.
- Provide an on-going, integrated programme.
- Exploit other events to help raise awareness and help ensure the message is well-received.

6.3.2 Summary of broad recommendations for increasing knowledge

- Experiential, activity based learning can be very effective.
- Use local examples and encourage site visits.
- Make sure messages are effective by framing appropriately.

6.3.3 Summary of broad recommendations for changing behaviour

- Allow plenty of time for the project to evolve.
- Provide incentives such as free propagation courses, seedlings, site visits, lunch.
- Identify barriers to the desired behaviour change.
- Increase people's capacity for change through providing new opportunities, skills, networks, etc.
- Segment strategies and information provision by audience.
- Provide strong leadership and be a good example.
- Target key individuals and demonstrate how individuals can be effective. Make the desired behaviour visible and 'normal'.

- Motivate people by demonstrating positive results over time. Emphasise immediate benefits as well.
- Instil feelings of responsibility for the project or project area. Consider an 'adopt-a-site' approach.
- Link up with other groups to reinforce the desirability of the behaviour. Activate interpersonal networks to legitimate the message and motivate people to act.
- Make 'emotional contact' with the natural world.

6.3.4 Summary of broad recommendations for achieving community participation

- Generate as many spin-offs as possible for participants such as health, fun, education, building social cohesion, increased capacities of individuals, etc
- Provide clear explanations and rationales (especially around those of a scientific nature) from credible sources.
- Monitor and evaluate both the task (objectives) and process (how these are being achieved).
- Provide adequate funds and, if possible, commit to long-term financial support. Annual funding rounds discourage long-term participation. Sometimes, pegging funding to achievements can be effective.
- Recognise that the participants generally take a holistic approach with their personal values, experiences and aspirations, and that these are tied to the project's objectives. Establish what it is the participants want out of their participation, and then determine whether this is consistent with the organisation's broad objectives.
- Continually seek the community's feedback and ensure good communication flows (through newsletters, meetings, etc). Consider having a long-term facilitator attached to the project. Alternatively, the idea of a community representative paid by the project/council could be worth exploring.
- Empower participants by recognising the value of their local knowledge and allow them 'preferential treatment' as a bonus attached to their participation, for example, preferential treatment might be along the lines of personal invitations to public meetings or other measures that can't generate too much jealousy but which reinforce the feeling of being valued for their commitment.
- Allow plenty of time for the project, particularly its initial stages where relationships need to be built, roles negotiated, stakeholders identified.
- Get everyone who will be affected/interested involved early using many media and face-to-face contact.
- Identify barriers to participation– for example, difficulties with transport, shyness, family commitments (actually, getting involved for the kids' sake can turn a barrier into a benefit), not believing their contribution will be worthwhile, too busy, not knowing people, not trusting the organisation or believing it will follow through, feeling consultation is just a token gesture...
- Provide incentives such as lessons, free plants, etc.
- Other recommendations include working with existing community structures (such as Scouts, church groups, etc), allowing people to contribute in different ways, holding meetings locally, having an open-door policy at community meetings, identifying possible conflicts of interest, setting clear (but flexible) objectives.

6.3.5 Specific Methods

- Pettigrew (1996) - television and radio advertisements are 'ephemeral', with the recipient unable to refer back to it. Print media (including advertisements in newspapers and leaflets) exist in space and can be referred to again and again. However, such material is easily skipped – by turning the page – if it does not grab the reader's attention.
- Pettigrew (after Wright (no date)) - the content of the message has the most impact on the recipient's involvement or engagement. If the level of involvement is low broadcast messages may have some impact whereas printed material will most likely be ignored. Conversely, if the degree of interest is already quite high, printed messages will probably generate some response. Factual material is best communicated in print.
- The appropriateness of different media may also be influenced by the issue's stage in the life-cycle of 'pre-problem', 'discovery' (sudden rise in attention and coverage), 'plateau' (complexities of problem are realised, enthusiasm wanes), and 'post-problem'.

7 State of the Takiwa. Te Āhuatanga o Te Ihutai. Cultural Health Assessment of the Avon Heathcote Estuary and its catchment.

7.1 Overview

While this work was not part of the RG suite of studies, it is related and arguably should influence RG programme development. The State of the Ihutai project produced an environmental monitoring and reporting system based on cultural priorities of tangata whenua. Its goal is to assist tangata whenua to analyse information on the cultural health of significant local resources, for management purposes (Pauling et al, 2007). This project is part of Ngāi Tahu 2025 Vision for Ki Uta Ki Tai – Mountains to the Sea Resource Management.

Thirty sites in the Avon/Otakaro, Heathcote/Opawaho and Avon-Heathcote Estuary/Ihutai were visited described and sampled. Literature and knowledge on past conditions of the waterways were used to develop a record of changes over time. Conclusions from the study are:

- “that the waterways are significantly damaged by the impacts of historical and ongoing drainage & untreated stormwater, the loss of native vegetation, including wetlands, grasslands and lowland podocarp forests, and the decline of water quantity within the catchment” (Pauling et al, 2007);
- that “although the catchment received a poor assessment, a number of sites and features were seen as positive and provide ideas for how future management may be able to improve the cultural health of the Ihutai catchment, including: the presence and abundance of remnant and/or restored native vegetation at sites such as Pūtarikamotu (Deans Bush), Waikākāriki (Horseshoe Lake), Ōruapaeroa (Travis Wetland), the Wigram Basin and Westmorland as well as the occurrence of freshwater springs at Jellie Park and Templetons Rd” (Pauling et al, 2007).
- that “protecting, enhancing & extending such areas & features, and dealing with sources of contaminants will be the most important challenges for the future management of the Ihutai catchment” (Pauling et al, 2007).

It is particularly noteworthy that this study came to conclusions regarding water quality that are very similar to those in the water quality data analysis reported above. In addition, The State of the Takiwa study found that “E.coli at 32% of all sites sampled showed resistance to antibiotics, with Ampicillin (a human antibiotic) being the most common”, suggesting that sewerage overflows into urban waterways is a major contributor to E. coli contamination (Pauling et al, 2007). This has significant impacts on Maori cultural values as well as general contact recreational values.

8 Discussion and Conclusions

There are some specific, measurable problems with water quality in Christchurch urban waterways (toxic pollution and nutrient enrichment, particularly in Haytons Drain, Curletts Road Drain, Addington Drain, Dudley Creek and Horseshoe Lake; and sedimentation in the Heathcote downstream of the confluence with and including Cashmere Stream). There are available remedies for these problems which the RG programme should employ. The RG programme should also establish investigations to identify how to address other water quality problems (notably E. coli contamination) for the purposes of restoring cultural and contact recreational values.

Ecological values are low in many parts of the waterways. This needs a multi-faceted response. Riparian planting is one facet of this response and the RG programme should foster riparian planting that supports diverse aquatic species. Ecological restoration may require fundamental changes to the Christchurch urban waterway landscape and the RG programme should investigate public support for such changes.

There are significant gaps in the scientific literature on urban waterways in Christchurch. The RG programme should include further scientific investigation where the results may contribute to overall RG objectives. Other gaps will have to be filled through other programmes (and possibly working with other research institutions such as the University of Canterbury).

The market survey of Christchurch residents produced a lot of high-value information for the RG programme. However, it was under representative of non-pakeha/European residents and further survey work on specific groups of residents is warranted.

The market survey indicates that general awareness of urban waterways is very low among Christchurch residents apart from the Avon and Heathcote main stems. Fewer than half of residents consider urban waterways to be healthy. There is overall a poor understanding of what causes damage to waterways, the waterway network (drains, stormwater channels, rivers and streams), but high concern and potential concern about stormwater entering rivers and streams. There is much to be gained from a RG programme that includes public education campaign to increase understanding and valuing of waterways. The RG programme should investigate social marketing approaches to targeted behaviour change only after further investigation of domestic chemical use in relation to waterway damage.

Christchurch residents are unlikely to voluntarily participate in communal waterway activities though targeting specific communities with higher levels of interest in waterways may elicit successful approaches. The RG programme should focus on work with local groups and their local waterways initially. The existing (ECan) 0800 pollution hotline may be successful if residents understand how to identify pollution.

The literature review on public engagement in waterway programmes produced highly valuable insights into programme success. The RG programme should utilise this literature to develop specific projects and those involved in RG should seek to enhance their knowledge and skills by interacting with waterway project leaders elsewhere in NZ. The RG programme should include evaluation of all projects.

On the basis of the information presented in this report, it is our view that the River Guardians Programme should have an overall aim of improving the ecological health of Canterbury urban waterways by engaging science, public involvement and local government together in finding and implementing solutions to waterway problems.

Achieving this aim is likely to take significant effort over several decades. As a first step in achieving the overall aim, the River Guardians Strategy should consist of 4 key objectives to be met during the term of the current LTCCP. The strategy should focus on specific tributaries of the Heathcote/Opawaho and Avon/Otakaro rivers because specific water quality and ecological problems have been identified in the tributaries and unless these are remedied, actions on the same problems in the mainstems will not be successful. The 4 key objectives should be to:

1. engage with Christchurch City Council to gain cooperation and coordination for River Guardians programme.
2. appoint a RG programme manager to oversee the RG programme.
3. reduce: a) sedimentation; b) toxic pollution; c) nutrient pollution, and d) faecal contamination of selected tributaries of the Heathcote/Opawaho and Avon/Otakaro rivers.
4. design and implement a Christchurch-wide education/social marketing programme to increase residents' understanding of the urban waterway 'networks' and impacts on and of waterway health.

A work plan to meet these objectives is set out in the attached document: River Guardians Strategy 2007/8 – 2015/16.

9 References/Sources

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