

Wairewa ZIP Addendum

November 2014



ACKNOWLEDGEMENTS

The Banks Peninsula Zone Implementation Committee would like to thank the Little River Wairewa Community for their interest and involvement in the preparation of this document. Over the last 18 months there have been many opportunities for the community to become involved.

- 2 drop in sessions where the technical experts attended and were able to share knowledge of the issues.
- A hui with the Wairewa Rununga
- A meeting with landowners in the upper catchment
- A fieldtrip to view some of the issues and meet with members of the community
- Experts working through with landowners their farming operations.
- Advertisements in the Akaroa Mail and the Zone Committee's newsletter s to outline some of the activities in the Little River Wairewa Catchment.
- The websites of the CCC and Environment Canterbury have been available to the community and have proceedings documented
- The Akaroa Wairewa Community Board flooding meeting in May 2014 following the storm events in March supported by the Zone Committee the CCC NZTA and Environment Canterbury
- Workshops and Zone committee meetings held in Little River that have been open to the community
- The minutes of the Zone committee have been included in the Community Board minutes and available on the CCC website.
- A number of open meetings were held in the catchment in preparation of the document with members of the community being given opportunities to discuss matters and hear presentations from the various technical teams

The Zone Committee also recognises the tremendous support of the CCC and the Environment Canterbury technical teams the administrative staff and the Zone Facilitator. The Canterbury Water Management Strategy and the processes involved have provided a platform to research and document a varied range of issues and moving forward it is hoped the catchment of little River Wairewa will continue to be a living working laboratory and we will all benefit from a 'better understanding of the issues'.

CONTENTS

ACKNOWLEDGEMENTS	
1.0 INTRODUCTION	
1.1 Introduction	5
1.2 Purpose of the ZIP Addendum	5
1.3 Starting Point	8
1.4 Significance to Ngāi Tahu and the Wider Community	9
1.5 Proposed Land and Water Regional Plan	10
2.0 ISSUES AND OUTCOMES	
2.1 Main Issues	11
2.2 Desired Outcomes	12
3.0 PRINCIPLES AND PATHWAYS	
3.1 Guiding Principles	14
3.2 Pathways and Leaders	15
4.0 GENERAL RECOMMENDATIONS	
4.1 Mauri – Mahinga Kai	17
4.2 Flood Risk	18
4.3 More Effective Solutions	18
4.4 Funding	19
4.5 Monitoring and Reporting	19
5.0 CATCHMENT RECOMMENDATIONS	
5.1 Flood Mitigation and Sediment Control	20
5.2 Environment Plans – Sediment and Phosphorus	21
5.3 Inputs of Phosphorus and Lake Assimilation	22
5.4 Flow Allocation	23
5.5 Minimum Flows	23
5.6 Exclude Stock from Waterways	24
5.7 Propagate Poplar Poles – Soil Conservation	25
5.8 Promote Indigenous Biodiversity	25
5.9 Wastewater Treatment – Phosphorus Removal	26
5.10 Dissolved Nitrogen - Waterways	26
5.11 Monitor and Adapt - Periphyton Growth	27
5.12 Consent Requirements – Riparian and In-Stream Works	27
5.13 Raise Awareness and Provide Education Opportunities	28
5.14 Raise Awareness – Private Water Supplies	29
6.0 TE ROTO O WAIREWA / LAKE FORSYTH	
6.1 Lake Opening – Clarify Objectives	30
6.2 Engineering Solutions – Lake Opening	31
6.3 Research – Drivers of Cyanobacteria Blooms	31
6.4 Engineering Solutions – Sediment and Phosphorus Legacy	32
6.5 Engineering Solutions – Retention Basin and Wetland	32

Wairewa ZIP Addendum – November 2014

6.5 Field Investigations	33
6.7 Control Black Swans and Canadian Geese Numbers	33
6.8 Research Changes in the Lake Ecology	34
6.9 Promote the Lake as a Low Speed Recreation Area	34
6.10 Management Plan – Te Roto o Wairewa	35
7.0 TIMELINE	36
8.0 ADDENDUM SUMMARY	37
APPENDIX 1: Technical Reports – References	38

1.0 INTRODUCTION

1.1 Introduction

The Banks Peninsula Zone Committee is a joint committee of Christchurch City Council and Environment Canterbury. The committee has been tasked to develop recommendations to improve the management of fresh water on Banks Peninsula that would deliver the ten targets of the Canterbury Water Management Strategy (CWMS): <http://ecan.govt.nz/get-involved/canterburywater/targets/Pages/Default.aspx>.

The ten target areas are:

- Kaitiakitanga
- Ecosystem Health and Biodiversity
- Environmental Limits
- Drinking Water
- Recreational and Amenity Opportunities
- Water-Use Efficiency
- Natural Character of Braided Rivers
- Irrigated Land Area
- Energy Security and Efficiency
- Regional and National Economies

To deliver the ten targets in Banks Peninsula the zone committee completed a Zone Implementation Programme (ZIP) in March 2013. The committee is now developing a more specific implementation programme for the Wairewa catchment; a ZIP Addendum to address the poor health of Te Roto o Wairewa/Lake Forsyth and to recognise the significance of the catchment to mana whenua, Kāti Irakehu and Kāti Makō. Wairewa Rūnanga is the modern assembly of the local hapū. Kāti Irakehu and Kāti Makō.

The catchment has been identified as a nutrient “red zone” in the proposed *Land and Water Regional Plan* (pLWRP).

Given the flood events of March and April 2014 and their significant effects on the households and businesses in the catchment, the zone committee felt that it was important to recognise the flood risk as a major issue and to include recommendations to reduce and manage that risk.

1.2 Purpose of the ZIP Addendum

The purpose of the ZIP Addendum is primarily to provide guidance to Environment Canterbury as it develops its work programme, budget and planning frameworks, including variations to the pLWRP. Furthermore, the ZIP Addendum will assist Environment Canterbury to respond to Government directions contained in the *National Policy Statement on Freshwater Management* and the *National Objectives Framework* that require regional councils to:

- Maintain or improve overall water quality within a region
- Safeguard the life support (including their associated ecosystems) of freshwater
- Set freshwater quality limits for all water bodies
- Establish methods to avoid over allocation

- Set a defined timeframe and methods by which over allocation has to be phased out
- Set environmental flows for all freshwater bodies.

The ZIP Addendum also provides recommendations and a sense of direction for others to follow and contribute towards.

This ZIP Addendum primarily focuses on recommendations to:

- Improve the health of Te Roto O Wairewa/Lake Forsyth and water management in the wider Wairewa catchment (refer Figure 1)
- Reduce the flood hazard in the catchment.

To undertake this task the committee has worked closely with the Wairewa Rūnanga and Akaroa/Wairewa Community Board to facilitate community discussion and input.

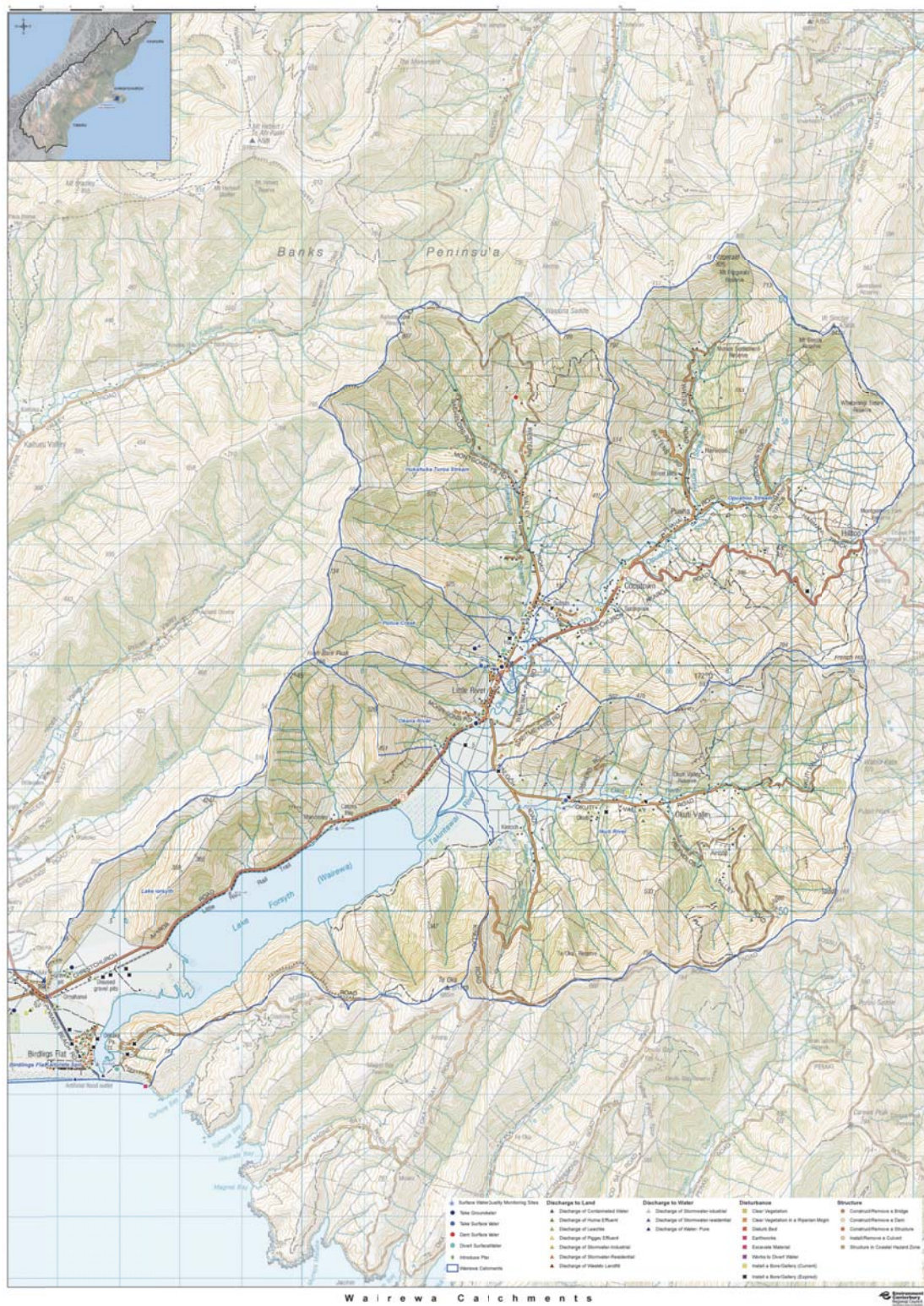
The zone committee has endeavoured to build on recent work, including:

- Research and trials undertaken by Wairewa Rūnanga
- The Banks Peninsula / Te Pātaka o Rākaihautū Zone Implementation Programme (ZIP) 2013
- The Mahaanui Iwi Management Plan 2013 <http://mkt.co.nz/mahaanui-iwi-management-plan/>
- The Christchurch City Council Mayoral Flood Taskforce 2014
<http://www.ccc.govt.nz/cityleisure/projectstoimprovechristchurch/landdrainage/taskforce.aspx>

Developing the ZIP Addendum has also generated new information that can be found in Environment Canterbury technical reports <http://ecan.govt.nz/OUR-RESPONSIBILITIES/REGIONAL-PLANS/REGIONAL-PLANS-UNDER-DEVELOPMENT/WAIREWA/Pages/wairewa-research.aspx>

The committee has tried to balance the economic, social, cultural and environmental needs of the community. Finding a sustainable, long-term balance has been difficult; there are no quick fixes for some of these issues but by working together we can coordinate a plan of action.

Figure 1: Wairewa Catchment



1.3 Starting Point

Over the last 160 years the catchment has been dramatically modified. The majority of native forest was removed between 1860-1890 to build Christchurch and provide for agriculture in the catchment. The lake level has been controlled to provide drainage for the lower catchment since the late 19th century. The lake has been mechanically opened since 1946.

As with areas that share a similar settlement history, the Wairewa catchment has suffered significant loss of indigenous species and wetland habitats. Deforestation led to erosion, and subsequent sedimentation rates in the lake have increased substantially from a pre-1840s rate. This has meant a major imbalance between inputs of sediment coming into the lake and sediment being able to exit the lake. The sediment coming into the lake from the Wairewa catchment is naturally high in phosphorus, which is believed to be one of the driving factors behind the regular blooms of the toxic cyanobacteria, *Nodularia spumigena*.

The lake is in a poor condition. It has undergone eutrophication since the early 1900s. Currently it undergoes significant fluctuations between eutrophic and extremely hypertrophic states. Cultural values, including mahinga kai, have declined substantially since European settlement.

Te Roto o Wairewa (Lake Forsyth) is a Statutory Acknowledgement site that recognises the mana of Ngāi Tahu, guaranteeing tribal involvement in its management. The lake is also one of only two customary lakes in New Zealand (the other is Lake Horowhenua), which means that only Ngāi Tahu iwi can take tuna (eels) from the lake.

The catchment is prone to flooding. The steep, short creeks and streams, current soil and vegetation cover have limited capacity to hold and slowly release water from intense rainfall events. Flooding has been common in the Ōkana and Ōkuti Valleys since the catchment was first occupied. Prior to 2012 the catchment experienced a decade without severely intense rainfall events, but in August 2012, and both March and April 2014, the Ōkana catchment experienced intense rainfall events that resulted in the flooding of several homes, businesses and roads including State Highway 75.

The Waitangi Tribunal recommended in respect to Te Roto o Wairewa that a management plan¹ be prepared for improvement of the water quality, involving Ngāi Tahu as part of the decision-making process along with the Department of Conservation, Canterbury Regional Council and the Ministry of Primary Industries, with the Crown providing the same resources as were recommended in respect to Te Waihora.

¹ This ZIP Addendum is a set of recommendations to Environment Canterbury and Christchurch City. It is not a management plan for Te Roto o Wairewa as envisaged by the Waitangi Tribunal.

1.4 Significance to Ngāi Tahu and the Wider Community

“Wairewa is one of the lakes referred to in the tradition of Ngā Puna Wai Karikari o Rākaihautū, which tells how the principal lakes of Te Wai Pounamu were dug by the rangatira Rākaihautu, the captain of the canoe Uruao which brought the tribe Waitaha to New Zealand. Rākaihautū beached his canoe at Whakatū (Nelson). From Whakatū Rākaihautū divided the new arrivals into two parties, with his son taking one to explore the coastline southwards and Rākaihautū taking the other southward by an inland route. On his inland journey Rākaihautu used his famous kō (a tool similar to a spade) to dig the principal lakes of Te Wai Pounamu, including Wairewa..... The mauri of Wairewa represents the essence that binds the physical and spiritual elements of all things together generating and upholding all life. All elements of the natural environment possess a life force and all forms of life are related. Mauri is a critical relationship of Ngāi Tahu Whānau with the ...”² Wairewa catchment.

Cultural

Te Roto o Wairewa was once a kete full of mahinga kai and famous for its tuna (eels), which provided sustenance for mana whenua, Kāti Irakehu and Kāti Makō.

Historical

Maori occupation around Te Roto o Wairewa and European sawmilling, farming and settlement means the catchment holds a prominent place in Canterbury’s historic landscape.

Wildlife habitat and biodiversity

Wairewa is a nationally and regionally significant wetland area that links with Te Waihora/Lake Ellesmere and the Avon-Heathcote Estuary/Ihutai. Te Roto o Wairewa is a shallow brackish coastal lake that provides lake-margin and swamp habitats for waterfowl (including the crested grebe), a variety of salt and freshwater marsh plants and invertebrate species. The lake and tributaries provide habitats for a variety of fish species including tuna (long finned and short finned eel), inanga (whitebait), patiki (flounder), banded kōkopu, and common and upland bullies. The Ōkuti is a known spawning site for the kanakana (lamprey *geotria australis*). Apart from the upland bully all these species require access to the sea to complete their lifecycle. Perch and brown trout can also be found in the streams and lake.

Landforms and landscapes

Te Roto o Wairewa is a relatively new lake. Prior to European settlement the lake was a tidal inlet. Early whalers described an inlet with a permanent opening to the sea known as Mowry (Māori) harbour. By the 1840s a barrier bar had naturally formed and the lagoon became a lake, trapping species that naturally move between salt and freshwater to complete their life cycle. The barrier beach continues to grow as gravel from rivers to the south is transported along the coast and deposited at Birdlings Flat, and the lake fills from sediment discharged from the catchment.

Recreational use and public access

Recreation is mainly concentrated on the west edge of the lake. Motorised boating is limited due to its

² Schedule 71 Statutory acknowledgement for Te Roto o Wairewa Ngāi Tahu Claims Settlement Act 1998

shallow nature. The New Brighton Power Boat Club does, however, hold annual regattas there every summer.

Other water-based activities are limited by cyanobacteria blooms in summer and associated health warnings. However the Little River Rail Trail is increasing in popularity providing a pleasant cycle ride or walk along the edge of the lake.

1.5 The Proposed Land and Water Regional Plan

The pLWRP is a new regional planning framework for Canterbury. It aims to provide clear direction on how land and water are to be managed to deliver community aspirations for water quality and quantity in both urban and rural areas

The pLWRP introduces nutrient management zones to indicate whether water quality outcomes are being met and the policies and rules that apply to the different zones. The Wairewa catchment has been identified as a red zone, indicating that water quality (i.e. lake quality) outcomes are not met. The pLWRP has policies and rules that address nitrates. The pLWRP measures are unlikely to affect landowners in the Wairewa catchment as nitrate discharges in this catchment are considered low (i.e. <10kg/ha/yr). Phosphorus-rich sediment, however, is considered to be the main contributor to poor water quality in the Wairewa catchment. The zone committee is investigating ways to reduce the phosphorus rich sediment entering and staying in the lake, while keeping nitrate levels low.

WAIREWA CATCHMENT – NUTRIENT RED ZONE pLWRP

The Wairewa catchment is designated a nutrient red zone in the pLWRP.

A red zone means there can be no increase in nitrogen leaching beyond the leaching baseline for farms already leaching more than 10 kgN/ha/yr.

Farms with higher leaching losses (>20kgN/ha/yr), can continue to operate until 1 January 2017, but after this date a resource consent is required and a completed farm environment plan is an essential component of the consent application.

2.0 ISSUES AND OUTCOMES

2.1 Main Issues

Health of the lake and waterways

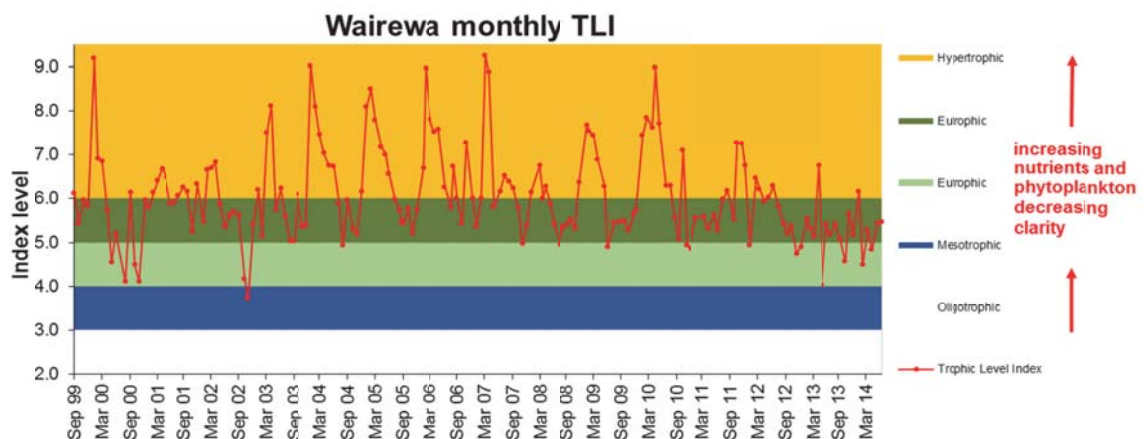
The health of Te Roto o Wairewa / Lake Forsyth is poor³. The accelerated inflow of phosphorus-rich sediment is a significant driver behind this decline.

A notable thing about the Trophic Level Index (TLI)⁴ of Wairewa / Lake Forsyth is its variability, with the lake moving between eutrophic and extremely hypertrophic levels (in contrast to Te Waihora/Lake Ellesmere which has a TLI that sits consistently at just above 7). The extreme hypertrophic peaks are in the summer when large algal and cyanobacteria blooms tend to occur. During the winter the lake is generally in a supereutrophic state (a TLI of 5-6).

A high eutrophic level generally means poorer water quality but does not mean that the lake is biologically dead. Te Roto o Wairewa / Lake Forsyth is biologically very active. Some species, such as tuna (eels), however, appear to be on the decline. The main water quality issue for the lake is cyanobacteria blooms. It is still uncertain exactly what drives these blooms. The trigger is likely to be hidden within the complexity of interrelationships and feedback loops between water temperature, salinity, phosphorus, nitrogen and oxygen levels.

The TLI values and variability have reduced over the last 2-3 years. Macrophytes (aquatic plants) flowered in the spring of 2013, which is a good sign and has led to cautious optimism that the health of the lake is improving. It is thought that these signs of improvement are a consequence of higher lake levels over summer achieved through greater control on the lake opening.

Figure 2



³ A state of the Takiwā assessment undertaken in 2005-06 highlighted the dramatic loss of health in the catchment's waterways from the head of the valley to the lake "source to sink". Ref p311 Mahaanui Iwi Management Plan 2013.

⁴ The Trophic Level Index is a way of combining four related variables (total nitrogen, total phosphorus, chlorophyll a, and water clarity) into a single number.

Mahinga kai

The degraded health of Te Roto o Wairewa / Lake Forsyth and its fisheries is regarded by Wairewa Rūnanga as the most significant issue in the catchment. There is a dramatic loss of cultural health from the upper catchment to the lower catchment and lake (i.e. source to sink). Although the lake continues to be a productive environment, its mauri has been severely degraded⁵.

Wairewa Rūnanga has a long-term vision and strategy to rehabilitate the cultural health of Te Roto o Wairewa / Lake Forsyth. The lake was gazetted in 2010 as a matāitai reserve to protect customary fisheries, in anticipation of the restoration of the health of the fishery⁶. Investigations and trialling of a better lake opening are well underway.

Flood hazard

Little River has a history of regular flood events. Flooding is largely due to flowing rather than ponding water. Large quantities of water flow down the steep catchment to the flatter lower valley where the Little River township is situated⁷. Three significant flooding events in 2014, on 4-5 March, 18 April, and 30 April, resulted in inundation of households, businesses and roads.

2.2 Desired Outcomes

The desired outcomes that the zone committee have identified for the Wairewa catchment have been developed from the *Banks Peninsula Zone Implementation Programme (ZIP)*, the *Mahaanui Iwi Management Plan*, the Mayoral Flood Taskforce, and discussions with the community and Wairewa Rūnanga.

Technical experts have also commented on the ability to achieve a TLI of 4, stating that a target TLI of 4 was “ambitious”⁸. Reflecting on this advice the zone committee decided to retain the target to provide a “stretch goal”, but to add restoration targets that specify:

1. A percentage of exceedances of chlorophyll a per year above 20µg/l; and
2. A maximum level of chlorophyll a of 50µg/l that should not be exceeded.

Chlorophyll a was chosen as a surrogate for the noxious (and toxic) cyanobacteria blooms in Te Roto o Wairewa / Lake Forsyth. Monitoring for chlorophyll a and reporting on exceedances will give a sense of whether the actions being taken are having a positive effect on the occurrence of cyanobacteria blooms.

⁵ Pg 310 Mahaanui Iwi Management Plan 2013

⁶ Pg 311 Mahaanui Iwi Management Plan 2013

⁷ Pg 84-87 Mayoral Flood Taskforce – Temporary Flood Defence: Measures Technical Report

⁸ Schallenberg (2014)



Desired Outcomes

CATCHMENT

Sediment discharges into waterways is reduced
All streams that flow into the lake are flourishing ecosystems reflecting mauri,
kaitiakitanga and mahinga kai values

FLOOD HAZARD

Risks of flooding are known and understood
The flood hazard is reduced

THE LAKE

Te Roto o Wairewa is a nationally significant project showcasing outstanding
environmental restoration
Annual Average TLI = 4 within 20 years (2035)
No more than 30% of water quality samples in a year have chlorophyll a levels above
20µg/l
Chlorophyll a levels should not exceed 50 µg/l
The lake supports mahinga kai and contact recreation all year round
within 15 years (2030)

3.0 PRINCIPLES AND PATHWAYS

3.1 Guiding Principles

The following principles underpin the recommendations of the zone committee. The guiding principles are:

Recognise Wairewa Rūnanga as a leader – Te Roto o Wairewa is a statutory acknowledgement site under the *Ngāi Tahu Claims Settlement Act 1989* and a customary fishery under Fisheries Regulation 1999.

Wairewa Rūnanga has long championed and led restoration of the lake and the catchment's water bodies and has investigated and trialled an alternative lake opening regime.

Ki uta ki tai (source to the sea) – Ensure an integrated approach from the top of the catchment to the lake opening, everything is linked to everything else.

Understand the biophysical system – Ensure an active research and monitoring programme is in place to better understand the complex interactions within the system. There is still a lot that we do not understand.

Avoid creating new or exacerbating existing problems – The catchment is flood prone. Future development should avoid flood prone areas and ensure that floor levels are above historic flood levels.

Ensure that flood mitigation and riparian management are mutually supportive – Clearance of flood debris and stabilisation of riverbanks should both improve drainage and reduce sediment discharge from bank collapse.

Control inputs before removing the sediment and phosphorus legacy – Inputs into the lake of sediment and phosphorus needs to be reduced so that future actions to remove the sediment and phosphorus legacy in the lake will not be negated by new inputs.

Develop partnerships – He tangata He tangata He tangata – People people people – Together we can make a difference.

Develop long-term commitment – Long-term and ongoing commitment from the community and agencies is required to improve and maintain the health of the lake, waterways and mahinga kai, and reduce the risk of flooding now and into the future.

Monitor, review and adapt – We need to proceed in an environment of uncertainty; we therefore need to assess and understand the effects of our actions and adapt to new information and understanding.

3.2 Pathways and Leaders

The outcomes in the ZIP Addendum will be achieved by many; each playing a part and working in a number of different ways, through a number of different mechanisms. No one agency or individual working alone can deliver the desired outcomes – we must work together.

The following lists some of the pathways and leaders, that when combined will deliver the desired outcomes for the catchment.

PATHWAYS	LEADERS
<u>Individual Action</u> Remove debris and manage storm water from properties and riparian margins; maintain septic tanks; ensure that water from stockyards, wash down facilities etc. does not flow directly into waterways or Christchurch city council storm water infrastructure.	<i>Individual Champions</i>
<u>Wairewa Mahinga Kai Cultural Park</u> Develop a Wairewa Mahinga Kai Cultural Park based on integrated management of the Te Roto o Wairewa catchment and surrounding landscape.	<i>Wairewa Rūnanga</i>
<u>Integrated Catchment Management⁹</u> Collectively manage willow clearance, bank erosion, land management and riparian planting along the catchment's water bodies, for flood mitigation and erosion control and to improve the health of water bodies and the lake ki uta ki tai.	<i>Community, Rūnanga, Community Board, Zone Committee, Christchurch City Council, Environment Canterbury and the Department of Conservation</i>
<u>District Plan</u> The District Plan can set a framework that provides for future subdivision in less flood prone areas of the catchment and set floor levels above historic flood levels for new development.	<i>Christchurch City Council</i>
<u>Water Related Services Bylaw</u> The Water Related Services Bylaw can require households to provide water tanks on site to supplement drinking water supplies and set standards for storm water entering the City Council's drainage network.	<i>Christchurch City Council</i>
<u>Navigation Safety Bylaw</u> The Navigation Safety Bylaw can set speed limits and classify areas as low speed areas.	<i>Environment Canterbury</i>
<u>Christchurch City Council Drainage Infrastructure - Maintenance and Improvements</u> Christchurch City Council maintains a drainage infrastructure in and around Little River and can provide for further maintenance or improvements in the Council Long Term Plan. The Council may also provide for improvements in the proposed comprehensive storm water consent for Banks Peninsula (expected 2015).	<i>Christchurch City Council</i>
<u>Christchurch City Council Waste Water Infrastructure</u> Christchurch City Council has scheduled a new reticulated wastewater treatment system for Little River in 2016-2019. Such a system could include phosphorus	<i>Christchurch City Council</i>

⁹ Integrated catchment management approaches sustainable resource management from a catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management.

stripping technology.	
<u>Wairewa section of the Land and Water Regional Plan (pLWRP)</u> The pLWRP provides a framework for managing competing demand for land and water in both rural and urban Canterbury. Nutrient limits and water allocation limits and controls on land use for the Wairewa catchment can be set in the plan.	<i>Environment Canterbury</i>
<u>Department of Conservation Management and Operational Plans</u> The Department of Conservation is a significant land manager, managing the lake bed and lake margin. The Department could provide for willow control and riparian management for areas it is responsible for in its operational plans.	<i>Department of Conservation</i>
<u>New Zealand Transport Agency Roadway Infrastructure – Maintenance and Improvements</u> The NZ Transport Agency maintains drainage from SH75 and can provide for further maintenance and improvements in its operational planning.	<i>NZ Transport Agency</i>
<u>Waitangi Tribunal recommendation – Management Plan te Roto o Wairewa</u> The Waitangi Tribunal recommended that the Rūnanga, iwi and agencies work together to prepare a management plan to improve the water quality of the lake. Developing an agreed plan would help coordinate the efforts of interested parties once there is confidence of the drivers behind the cyanobacteria blooms.	<i>Wairewa Rūnanga</i> <i>Ngāi Tahu</i> <i>Department of Conservation</i> <i>Ministry of Primary Industries</i> <i>Environment Canterbury</i> <i>Christchurch City Council</i>

4.0 GENERAL RECOMMENDATIONS

RECOMMENDATIONS	ISSUES
<p>4.1 Mauri¹⁰ - Mahinga Kai</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Christchurch City Council, Environment Canterbury, the Department of Conservation, Wairewa Rūnanga and the community work together to restore and maintain the health and mauri of Te Roto o Wairewa / Lake Forsyth and associated waterways of the Ōkana and Ōkuti catchments.</p> <p><u>Commentary</u></p> <p><i>Te Roto o Wairewa is significant for Ngāi Tahu, and its essence as a food basket lies at the heart of Wairewa Rūnanga (Kāti Makō and Kāti Irakehu). Restoring the health of the lake and its tributaries to a level that can once again support healthy, abundant mahinga kai is an important step in a long journey to restore the mana of the people.</i></p> <p><i>The zone committee expects that the implementation of this recommendation will go some way towards the development of a Mahinga Kai Cultural Park for the Wairewa catchment.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>



¹⁰ Mauri is the life supporting capacity, spiritual essence, life, health and vitality of the waterways and lake. Mauri and mahinga kai is used in these recommendations to also indicate ecological health.

<p>4.2 Flood Risk</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Christchurch City Council and Environment Canterbury recognise that a primary barrier to a healthy vibrant community is the risk from future flooding. The councils need to continue to work with the community to reduce and manage the flood risk to an affordable level.</p> <p><u>Commentary</u></p> <p><i>Flooding in the Wairewa catchment is caused by large quantities of water flowing from the steep upper catchment and slowing on the flatter lower valley where the township is situated. There is a small amount of Christchurch City Council drainage infrastructure around the township. There has been minimal maintenance of the rivers for drainage within the catchment in recent years leading to the establishment of extensive vegetation, particularly willow trees, along and within the river corridor (Mayoral Flood Taskforce 2014).</i></p> <p><i>There have been a number of attempts to improve the condition of the waterways in the catchment for drainage. These have included an agreement in 1993 for government workers to undertake work to bring the waterways up to a standard that could be maintained by private landowners; and in 2008 an Environment Canterbury-led process to establish a drainage rating district. Both of these attempts have failed to eventuate in long term programmes to maintain the waterways to a satisfactory standard for drainage.</i></p> <p><i>The zone committee believes it is time for the community to work together to find a solution and develop a work programme and funding models to ensure ongoing work and maintenance of the catchment waterways for the long term. Such a work programme will have the biggest impact in achieving social, cultural, economic and environmental outcomes.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>
<p>4.3 More Effective Solutions</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The community, Wairewa Rūnanga, Christchurch City Council, Environment Canterbury, Department of Conservation and researchers be encouraged to seek more effective and innovative solutions to the issues in the catchment.</p> <p><u>Commentary</u></p> <p>Currently there are no easy solutions that will immediately remedy the poor water quality in the lake, restore mahinga kai, or ensure no more flooding in the catchment. The zone committee is supportive of the research and trials the Wairewa Rūnanga has undertaken over recent years to find ways to improve the health of the lake and the efforts of the local community to explore new funding models for flood mitigation work. The committee would like to see others taking a similar innovative approach and would like to see new ideas encouraged and supported by agencies.</p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

<p>4.4 Funding</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The community, Environment Canterbury and Christchurch City Council work together to develop funding models to support the implementation of these recommendations that include, but not be limited to, council annual and long-term plans and budgets, and community, regional and national funding opportunities.</p> <p><u>Commentary</u></p> <p><i>The recommendations in this ZIP Addendum are multi-faceted and ambitious, and span the responsibilities of individuals, councils, government agencies and communities. Implementation will require funding from a variety of sources.</i></p> <p><i>The zone committee believes that all parties with an interest in the Wairewa catchment will need to work together to develop funding models that are widely accepted and affordable. Such models may also include applying for funds from outside sources.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>
<p>4.5 Monitoring and Reporting Programme</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury, Christchurch City Council and the Department of Conservation develop a monitoring programme that complements existing monitoring, in order to provide the community and Wairewa Rūnanga with regular updates on:</p> <ul style="list-style-type: none"> • the health of the lake and waterways • the health and abundance of mahinga kai • the flood risk and preparedness for flood events. <p><u>Commentary</u></p> <p><i>The zone community recognises that we do not fully understand the drivers of the health of the lake and the effectiveness of the zone committee's proposed recommendations. The committee is, however, confident that there is enough information to take action to support and build on the efforts of Wairewa Rūnanga, the community, councils, the Department of Conservation and others.</i></p> <p><i>To manage these uncertainties and build confidence in the effectiveness of the actions taken the zone committee believes it is important to monitor and regularly report to the community and Wairewa Rūnanga on the health of the lake and waterways in the catchment, and to adapt work programmes, including the effectiveness of the plan provisions, to new information and understanding.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

5.0 CATCHMENT RECOMMENDATIONS

RECOMMENDATIONS	ISSUES
<p>5.1 Flood Mitigation and Sediment Control The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury and Christchurch City Council support a <u>working party of Wairewa Rūnanga</u>, community members and relevant agencies to develop:</p> <ul style="list-style-type: none"> • a work programme • funding models that have the support of the community and councils, and are sustainable and affordable for the long-term. <p>Christchurch City Council should provide in their long-term plan to:</p> <ul style="list-style-type: none"> • maintain and improve Christchurch’s City Council drainage infrastructure in the catchment. <p>Christchurch City Council should provide in their District Plan:</p> <ul style="list-style-type: none"> • provisions to avoid new development in flood prone areas • regulated floor levels for new households and extensions above a “1 in 200 year flood level”. <p>Environment Canterbury should provide in their Long-Term Funding Plan to:</p> <ul style="list-style-type: none"> • support a drainage rating district (or mutually agreed funding model) if one is agreed to by the community • provide a river engineer to work with the community to manage the work programme and act as a contact point for drainage issues (outside CCC drainage network). <p>Individual property owners should be encouraged to:</p> <ul style="list-style-type: none"> • keep drains and waterways on their property clear of debris • avoid wash down areas where contaminants can enter the storm water system and waterways • work with neighbours to manage storm water • permanently reforest less productive areas in the upper catchment where appropriate to intercept and absorb rain and slow runoff • encourage native plantings where appropriate. <p>The community should be encouraged to:</p> <ul style="list-style-type: none"> • develop an emergency plan of action. <p>Christchurch City Council and Environment Canterbury should ensure information is easily available covering matters such as:</p> <ul style="list-style-type: none"> • flood history and risks • roles and responsibilities • actions to reduce flood risk • rationale and timing for RMA consents regarding work in or near waterways • The state of the lake and waterways. 	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

<p><u>Commentary</u> Refer to recommendation 4.2.</p> <p><i>Understanding, adapting to, and reducing the flood hazard in the Wairewa catchment will require all parties to work together and take action. The zone committee believes the most effective action will come from a long-term coordinated work programme supported by a funding model developed and agreed to by the community, that councils can then work with the community to implement. The zone committee supports the community and Akaroa-Wairewa Community Board initiating a Working Party of community members to develop a programme and funding model that is agreed by the community and can then be factored into council plans and budgets. Landowners, councils and agencies also need to take responsibility for drainage from their own land and infrastructure.</i></p> <p><i>The community will need to adopt a strategy of mitigating where it can, avoiding and adapting to flood risk. The zone committee believes it is important for the risk to be well communicated and understood; for weather warnings to be communicated so that the community can prepare; and when physically possible for the lake to be opened and the lake level lowered prior to forecasted intense rainfall events.</i></p>	
<p>5.2 Environment Plans - Sediment and Phosphorus The Banks Peninsula Zone Committee recommends that:</p> <p>Land managers with erosion and storm water hot spots and, land with waterway boundaries and/or with waterways running through properties be encouraged to prepare <u>environment plans</u> to focus attention on the reduction and management of:</p> <ul style="list-style-type: none"> • Sediment (and phosphorus) entering waterways • Stream bank collapse • Storm water from properties and roading infrastructure • Stock exclusion and access across waterways • Debris and willows impeding water flowing in waterways. <p>Environment plans are written to foster good management and may include but not be limited to:</p> <ul style="list-style-type: none"> • Identification of high risk sites where sediment is likely to be discharged • Actions to reduce sediment discharges (e.g. sediment traps, planting, diverting water away from erosion prone areas) • Regular clearance of drains and small waterways • Stock exclusion • Stock crossings (i.e. culverts and bridges) and drinking bays • Fencing and planting of waterways where it will not impede drainage. <p><u>Commentary</u> Refer to recommendations 5.3, 5.6 and 6.4</p> <p><i>Soils in the Wairewa catchment are rich in phosphorus and prone to erosion. When sediment is discharged into the waterways and the lake in the catchment, phosphorus is also discharged. Phosphorus has been identified as a likely limiting factor contributing to the poor water quality in the lake and the occurrence of</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

<p><i>cyanobacteria blooms.</i></p> <p><i>The zone committee believes that it is important to reduce the amount of sediment finding its way into the waterways and the lake. To do this many small actions will need to be taken by landowners. The first is to identify the source of sediment and then devise individual solutions to reduce the discharge. Experts suggest there are three main types of erosion “hot spots” in the catchment – riverbanks, hill country slips that connect with surface water, and tunnel gully erosion on the lake edge.</i></p> <p><i>The zone committee believes that environment plans are a good way for land owners, large and small, to identify “hot spots” of soil erosion and to focus attention on the development of site specific actions.</i></p>	
<p>5.3 Inputs of Phosphorus and Lake Assimilation The Banks Peninsula Zone Committee recommends that:</p> <p>A target of 1700kg phosphorus per annum enters the lake within 20 years (2035). Reduce the discharge of phosphorus rich sediment into the lake by approximately 85% over 20 years (2035).</p> <p><u>Commentary</u> <i>The lake currently receives more phosphorus from its tributaries than it can assimilate or flush when the mouth is open. It is estimated (Waters 2014) that in the order of 11,300kg of phosphorus enters the lake per annum and approximately 1,700kg phosphorus leaves the lake, leaving 85% or 9,600kg per annum¹¹ in the lake. Most of the phosphorus that enters the lake is bound in sediment. It is estimated that approximately to 10 -16,000 tonnes of sediment per year (i.e. 1000 – 1600 trucks of sediment) is discharged to the lake via the Ōkana and Ōkuri rivers.</i></p> <p><i>This is a longstanding problem accelerated by the clearance of forest in the 1800’s and the permanent closure of the lake by Kaitorete Spit.</i></p> <p><i>The zone committee is of the view that the inputs of phosphorus rich sediment need to be substantially reduced and managed before tackling the deposits in the lake. Its goal is to set a phosphorus limit that equals what can naturally be assimilated by the lake or flushed out to sea when the lake is open. To achieve this it recommends prioritising the bank and riparian management along the valley floor to reduce riverbank erosion and sediment discharges.</i></p> <p><i>The committee suggests a target reduction of 2,400kg of phosphorus every five years for 20 years. Targets of phosphorus input the lake are;</i></p> <p style="padding-left: 40px;">8,900kg P per year by 2020 6,500kg P per year by 2025 4,100kg P per year by 2030 1,700kg P per year by 2035</p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

¹¹ 9,600 kg P per annum is currently our best estimate of the difference in phosphorus entering the lake and departing through the opening.

<p>5.4 Flow Allocation</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP treats the Ōkana and Ōkūti catchment as two separate catchments when approaching water allocation.</p> <p><u>Commentary</u></p> <p><i>The zone committee understands that the only water body currently considered over-allocated in the catchment is Police Creek. Police Creek currently has one consented water take. Christchurch City Council has consent to take water from Police Creek for the Little River community water supply.</i></p> <p><i>The zone committee's objective is to ensure that water in the Wairewa catchment is not over-allocated. It understands that by adopting an allocation approach that divides the catchment in two will mean that Police Creek will not be protected by a separate minimum flow other than that of the Ōkana. Under the current consent Police Creek could be drawn down to very low levels in order to supplement the Little River community water supply. The committee feels that on balance it is important to maintain a reliable community water supply and that this may mean that the in-stream values of Police Creek are not protected by minimum flows and are sometimes compromised. The committee, however, felt that the remainder of the Ōkana and Ōkūti catchments need the protection that is afforded by minimum flows.</i></p> <p><i>The zone committee wishes to encourage Little River residents to adopt alternative sources of supply (e.g. rainwater tanks, water efficiency devices and appropriate garden planting), and for Christchurch City Council to supplement the supply by using its groundwater consent when Police Creek is low. Christchurch City Council could also investigate the feasibility of installing a water storage facility if the alternative groundwater supply was not sufficient.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>5.5 Minimum Flows and Lake Levels</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP adopt a flow allocation for the Ōkana and Ōkūti with a minimum flow of 90% MALF¹² and a total allocated volume of 30% MALF.</p> <p><u>Commentary</u></p> <p><i>Minimum flows are critical as low flows put stream ecology under stress. Small streams such as those in the Wairewa catchment are particularly susceptible to the negative impacts of low flows. The zone committee recognises that the Ōkana and</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

¹² Mean Annual Low Flow (MALF) means the average, over a number of years, of the annual lowest daily flows. This is determined by selecting the lowest daily flow (average over 24 hours) for each year of record, summing those values and then dividing the total by the number of years of record. Seven Day Mean Annual Low Flow (MALF7) is determined by adding the lowest seven day duration low flow for every year of record and dividing by the number of years of record (in any year the seven day low flow is the lowest average flow sustained over seven consecutive days).

<p><i>Ōkuti Rivers have significant biodiversity values including spawning sites for the New Zealand lamprey (kanakana, Geotria australis). The committee wishes to maintain and where possible improve the habitat for indigenous species and the abundance of mahinga kai in these water bodies.</i></p> <p><i>The zone committee believes that a minimum flow of 90% MALF7 and total volume of 30% MALF7 (refer Proposed National Environmental Standards on Ecological Flows and Water Levels¹³) offers an appropriate level of protection for species in the Wairewa catchment. This approach also provides for more water to be allocated, leaving room for a small amount of further development and/or room to adapt to climate change.</i></p> <p><i>This approach will reduce the reliability for current consent holders on the Ōkara from 98% to 91%, which could be offset by the installation of a small storage scheme.</i></p> <p><i>The committee also considered setting a minimum lake level to balance inflows with outflows in summer (i.e. inflows from streams = evapotranspiration). This was to ensure that the lake could be set at a level that reduced the likelihood of cyanobacteria blooms in summer. The idea was not pursued as the committee decided that limited actions could be taken if the lake fell below the minimal lake level. There are only five active water takes in the catchment. Surface water accounts for a total of 12.5 l/s and groundwater for a total of 30.5l/s. Limiting these takes would have minimal effect on the lake level yet significant effect on households; in particular those supplied by Christchurch City Council's community water supply.</i></p>	
<p>5.6 Exclude All Stock from Waterways The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP excludes all stock from waterways in the lower catchment of both the Ōkara and Ōkuti Rivers by 2020 and that landowners be supported with education, advice and funding.</p> <p><u>Commentary</u> Refer recommendations 5.2, 5.3 and 5.12</p> <p><i>The zone committee wishes to reduce the input of phosphorus-rich sediment into the waterways of the catchment and the lake. Expert advice (Lynn 2014¹⁴) concluded that undercutting and stream bank erosion in the river channels of the valley floor are the primary sources of suspended sediment to the lake in all flow regimes. This is where fine grained silt dominates. In the Ōkara catchment this area extends from the vicinity of Church Road Bridge to the lake and Usshers Road Bridge to the lake in the Ōkuti catchment.</i></p> <p><i>The purpose of excluding stock from stream banks is to stop stock exacerbating stream bank erosion and pugging and re-suspension of sediment in the stream bed. Stock can also damage riparian vegetation that has been planted to stabilise banks</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

¹³ Proposed National Environmental Standards on Ecological Flows and Water levels
<http://www.mfe.govt.nz/laws/standards/ecological-flows-water-levels/index.html>

¹⁴ ECAN Report No R13/103

<p><i>and improve ecosystems.</i></p> <p><i>In addition, the zone committee decided that a programme that encourages remediation and ongoing maintenance of riparian margins along the valley floor should be considered by the Working Party on Flood Mitigation.</i></p>	
<p>5.7 Propagate Poplar Poles – Soil Conservation</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury increases the number of poplar poles that it propagates and make these available at cost to landowners wishing to undertake soil conservation activities on erosion prone land.</p> <p><u>Commentary</u> Refer recommendation 5.12.</p> <p><i>Banks Peninsula is erosion prone. The pLWRP identifies much of the hill country of Wairewa catchment as high soil erosion risk (pLWRP map B077). Hewson (2014)¹⁵ suggests a number of actions that can be taken to reduce sediment discharges from slips and tunnel gullies by planting rapidly growing species such as poplars. Once stabilised, areas should then be planted in slower growing native species.</i></p> <p><i>The zone committee considers that making poplar poles available at cost is a practical way to encourage landowners to take action. Landowners should also be encouraged to place group orders so that costs could be reduced further.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>5.8 Promote Indigenous Biodiversity</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The community, Wairewa Rūnanga, Environment Canterbury, Christchurch City Council and the Department of Conservation be encouraged to plant indigenous species for sediment and erosion control, stream health and to develop ecological corridors across Banks Peninsula.</p> <p><u>Commentary</u> <i>The zone committee considers the protection and restoration of indigenous biodiversity to be a priority in the zone, no more so than in the Wairewa catchment. The catchment provides rare “source to sea” habitats for both flora and fauna. The zone committee wishes to protect the remaining indigenous biodiversity in the catchment and build on this resource by encouraging the utilisation of indigenous species wherever practicable for soil conservation, stabilising stream banks and to reduce the negative effects of intense rainfall events.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

¹⁵ Draft report - *Sediment Management Options for Hill Slopes in the Lake Forsyth/Te Roto o Wairewa Catchment*- Dave Hewson, Opus 2014

<p>5.9 Wastewater Treatment - Phosphorus Removal The Banks Peninsula Zone Committee recommends that:</p> <p>Christchurch City Council provides for advanced wastewater treatment that includes phosphorus removal and land disposal (including wetlands) of treated effluent when designing the new wastewater plant and reticulation system planned for 2017-2019.</p> <p>The pLWRP should require landowners to ensure that septic tanks in flood prone areas are sealed to prevent inundation from flood waters.</p> <p>Landowners should be encouraged to reduce the volume of wastewater by using systems such as low flush toilets and grey water recycling.</p> <p><u>Commentary</u> <i>Christchurch City Council has planned a new wastewater plant and reticulation system for Little River in 2017-2019. The zone committee believes it is important to reduce the inputs of phosphorus in the catchment's waterways and the lake. Wastewater is one source of phosphorus (predominantly derived from household soaps and detergents).</i></p> <p><i>The zone committee believes that Christchurch City Council should take the opportunity to include tertiary treatment for the effective removal of phosphorus in the new wastewater treatment plant planned for Little River. The committee also prefers land disposal options for treated effluent and wishes to see these options fully investigated as part of the planning process.</i></p> <p><i>Not all households are on, or are likely to be on, a reticulated wastewater system. The zone committee wishes to ensure that in the event of a flood raw sewage from septic tanks does not mix with flood waters. Landowners with septic tanks should also ensure they are maintained regularly to limit the risk of contamination of waterways.</i></p> <p><i>The zone committee wishes to encourage the reduction of wastewater by promoting the use of low water or water recycling systems. Composting toilets may also be an option in areas well above historic flood levels.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>5.10 Dissolved Nitrogen in Waterways The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP sets a dissolved nitrogen limit of a five year average of 0.2mgN/L.</p> <p><u>Commentary</u> Current monitoring indicates that the Ōkara River has an average concentration of 0.17mgN/L. At this level 99% of aquatic species will be protected from nitrate toxicity. This is also well within the "A" classification under the <i>National Objectives Framework</i>. The National Bottom-line for nitrate toxicity is 6.9mgN/L.</p> <p>The zone committee wishes to keep the nitrate concentration in the waterways low but leave some room for a small increase in development. The committee therefore</p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

<p>decided to set a nitrate limit that allows an increase from that currently measured of 0.03mgN/L. This is still well within the “A” classification under the <i>National Objectives Framework</i>.</p>	
<p>5.11 Monitor and Adapt - Periphyton Growth The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury continues to monitor the streams in the Wairewa catchment for periphyton growth to determine whether further action is needed.</p> <p><u>Commentary</u> <i>Periphyton (i.e. algae, cyanobacteria, and heterotrophic microbes) accumulation is dependent on nutrient levels (nitrogen and phosphorus) and the frequency of flushing flows (small floods). Excess periphyton inhibits the growth of invertebrates in the stream and is a nuisance for recreational values. Current monitoring shows no particular problems with periphyton growth in the catchment and the nutrient limits recommended here should ensure it stays this way.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>5.12 Consent Requirements – Riparian and In-Stream Works The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury considers ways to streamline and simplify the consenting process for works in stream beds and on the edges of streams. These could include:</p> <ul style="list-style-type: none"> • systems for ensuring consistent advice (e.g. one point of contact) • global consents • simplified consent processes • reconsideration of the controls set in the pLWRP. <p>The committee is mindful however that removing willows and other works can exacerbate erosion and flooding risk. These matters must be considered when deciding on the appropriate level of controls in the pLWRP.</p> <p><u>Commentary</u> <i>There was a lot of discussion on the need for consent from Environment Canterbury to undertake work to clear willows and debris that restrict the flow of flood water and reduce drainage capacity. After receiving advice from flood engineers that uncontrolled clearance could exacerbate river bank erosion and cause more damage from flood events the zone committee decided to keep the threshold as it currently is in the pLWRP, and to encourage the community to develop a coordinated programme of work (refer Recommendation 5.2).</i></p> <p><i>The zone committee felt that more effective management of the waterways, particularly the Ōkana and Ōkutu to reduce flood risk and erosion, could be achieved by a coordinated work programme developed by the community and funded by the formation of a community scheme (or rating district) where consents for work were held by the river engineer unit at Environment Canterbury or Christchurch City. This approach would not restrict activities such as trimming branches and keeping culverts clear, that do not disturb the bed of a waterway or cause contamination. In an emergency it may be possible to undertake larger scale activities without a resource consent but some form of written permission from Environment Canterbury would still be required.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

<p><i>The zone committee recognises the difficulty some landowners have had in receiving consistent advice from Environment Canterbury. The committee has recommended that Environment Canterbury clearly identifies a point of contact for consent enquiries. If the community agrees to a rating district a global consent is likely to be held by Environment Canterbury river engineers on behalf of the drainage district, and a river engineer responsible for the work programme would become the point of contact.</i></p>	
<p>5.13 Raise Awareness and Provide Education Opportunities The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury, Christchurch City Council, Department of Conservation, Canterbury District Health Board, NZ Transport Authority and others work together to raise awareness and understanding on, but not be limited to, the following:</p> <ul style="list-style-type: none"> • integrated catchment management • soil conservation and erosion control (including the planting of species such as poplars and sediment traps) • managing storm water runoff - individual properties (urban and rural) including the road corridor • managing potential causes of contamination (e.g. vehicle wash-down sites, stockyards and garages and sheds) • managing water bodies and riparian margins • encouraging indigenous biodiversity • encouraging water conservation and efficiency • encouraging water storage (i.e. rainwater tanks) • discouraging the use of detergents containing phosphorus • encouraging regular maintenance and upgrading of septic tanks • preventing waterways becoming a conveyance for the spread of weeds • sharing information on the state of the environment monitoring including the latest's findings from research and trials • celebrating the successes and the champions that made it happen. <p><u>Commentary</u> <i>Refer to recommendation 5.7</i></p> <p><i>Raising awareness and education are the keys to developing community understanding, acceptance and the will to take action. The zone committee strongly believes in the importance of working with the community in ways that best suit the community including building on the work and experience of others.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

<p>5.14 Raise Awareness – Private Water Supplies</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Small groups and individuals be made aware of potential contamination of their private water supplies, and be encouraged to have their water tested and act if needed.</p> <p><u>Commentary</u></p> <p><i>The zone committee considers it important for the community to know where their water comes from. If water is sourced from supplies outside the Christchurch City Council's reticulated system, it is important to know the source and the potential for contamination. If there is doubt or if there are concerns about contamination, samples can be taken from the tap and tested by a certified laboratory, and appropriate action taken.</i></p>	
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6.0 TE ROTO O WAIREWA/ LAKE FORSYTH

RECOMMENDATIONS	ISSUES
<p>6.1 Lake Opening – Clarify Objectives</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP should allow for the management of the lake opening for the primary purposes of:</p> <ul style="list-style-type: none"> • Mauri and health of the lake: Health of the lake appears to be improving as indicated by the TLI, which suggests a link to tighter control on the lake opening • Enhancement of mahinga kai: This would allow for the seasonal recruitment (Sept-Oct) and migration (March-April) of mahinga kai species between the lake and the sea • Effective drainage of excessive water from heavy rainfall events. <p>When opening the lake, consideration should be given to access across the shingle beach to Bossu Road where practical, provided that the Department of Conservation grants an appropriate concession.</p> <p><u>Commentary</u></p> <p>The zone committee is of the view that the lake opening regime should be driven by three important factors: mauri of the lake, mahinga kai and drainage. The needs for wading birds should also be considered.</p> <p>Access across Birdling’s Flat Beach to Bossu Road is important to the local community and should be provided for where practical. However, the zone committee believes that access should not be at the expense of the mauri of the lake, mahinga kai and/or effective drainage.</p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>



<p>6.2 Engineering Solutions – Lake Opening</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Wairewa Rūnanga, Christchurch City Council, Environment Canterbury and researchers continue to investigate and trial engineering solutions to improve control of the lake opening.</p> <p><u>Commentary</u></p> <p><i>The opening of the lake exerts a significant influence on the health of the lake, mahinga kai, the ability to respond in a timely manner to storm events and the need for drainage. Finding more effective and efficient ways of opening the lake and controlling lake levels has been an ongoing process since the lake was first artificially opened.</i></p> <p><i>The most recent change in the opening regime has been a trial to open the lake closer to the cliffs at the northern end of Bridling’s Flat Beach. The canal means an opening can more easily be created giving greater control of the lake level. A consent is currently being sought by Christchurch City Council and Wairewa Rūnanga to make this opening regime more permanent.</i></p> <p><i>The zone committee recognises the dynamic nature of the beach environment, the geological processes at play and the hazardous environment workers are placed in when opening the lake. The committee considers that it is important to continue to investigate and trial engineering options to improve the lake opening, keeping an open mind to new emerging technology. A number of engineering solutions have been suggested, including a weir or culvert similar to Waihao Box or Tentburn north of the Rakaia.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>6.3 Research Drivers of Cyanobacteria blooms</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Environment Canterbury and researchers investigate further the causes of the cyanobacteria blooms in the lake.</p> <p><u>Commentary</u></p> <p><i>Te Roto o Wairewa/Lake Forsyth suffers regular blooms of Nodularia, a toxin producing, nitrogen-fixing cyanobacteria. A theoretical model links cyanobacteria blooms to phosphorus loading. Schallenberg (2014) found no direct evidence for the existence of substantial internal phosphorus loads in Te Roto o Wairewa/Lake Forsyth; however circumstantial evidence suggests that internal phosphorus loading could be important at particular times. A salt water wedge, water temperature, nitrate, ammonium and oxygen levels may also exert an influence. Plankton grazers and the availability of micronutrients (e.g. iron and cobalt) may also play a role.</i></p> <p><i>Given the uncertainty about what is driving the cyanobacteria blooms the zone committee concluded that it was prudent to focus on further research and understanding of the underlying drivers and their complex feedback loops before committing to engineering solutions that may not substantially reduce the Nodularia bloom frequency or intensity.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>

<p>6.4 Engineering Solutions –Sediment and Phosphorus Legacy</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Wairewa Rūnanga, Environment Canterbury, Christchurch City Council, the Department of Conservation and researchers continue to work together to further investigate and pilot engineering solutions to remove excessive phosphorus-rich sediment from the lake bed, informed by a better understanding of the causes of the cyanobacteria blooms. Investigations and trials could include but are not limited to:</p> <ul style="list-style-type: none"> • dredging specific areas of the lake • wetlands around the lake margin • creating artificial floating wetlands • encouraging the growth of macrophytes in the lake. <p><u>Commentary</u></p> <p><i>Refer recommendation 4.3 and 6.3.</i></p> <p><i>Given the uncertainty about the drivers of the cyanobacteria blooms the zone committee felt that it was premature to commit to one or two engineering solutions that may not address the underlying problem. The committee was of the view that it is important to first understand the lake system before committing to significant and potentially invasive engineering solutions. However, it also felt the need to continue to look for effective options while further research on the drivers of cyanobacteria blooms was underway and that interested parties should to be encouraged to work together on further research and trials.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>6.5 Engineering Solutions– Retention Basin and Wetland</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>A 15 hectare, 3 metre deep sediment retention basin at the head of the lake augmented by a 5 hectare wetland on the lake fringe be constructed.</p> <p><u>Commentary</u></p> <p>Sedimentation and its accompanying phosphorus is the most significant issue that can be addressed to improve the quality of water in the lake. The sediment retention basin would intercept sediment and allow it to settle out before being emptied of sediment, while the wetland further down the catchment would strip out nutrients and add to the indigenous biodiversity around the lake. Wetland species could be chosen for their productive use. Such a system of intercepting sediment and stripping nutrients would need to be designed in a way that would not increase the flood risk. The zone committee envisaged that a feasibility study would be completed in 2015 and the system would become operational by 2020.</p> <p>Painter¹⁶ (2014) has concluded that a sediment retention basin at the head of the lake is technically feasible. An indicative cost of a combined sediment retention basin and wetland is in the order of:</p> <ul style="list-style-type: none"> • \$0.4 – 0.8 million for a 15 ha sediment retention basin (excluding land purchase and ongoing maintenance i.e. sediment removal) • \$1 million for a 5ha wetland (excluding land purchase) 	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

¹⁶ ECAN Report No R14/32

<p>6.6 Field Investigations</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>The pLWRP provides for field investigations to reduce phosphorus input by 9,600kg per annum by simplifying and reducing consent processes.</p> <p><u>Commentary</u> Refer recommendations 6.4 and 6.5</p> <p><i>Reducing phosphorus rich sediment entering and remaining in the lake will require significant intervention and/or engineering works, the details of which are currently uncertain. Further research and investigation, including possible field trials will be needed. The zone committee considers the pLWRP should anticipate this, and provide for small-scale field trials and investigations without removing the rights of Wairewa Rūnanga to exercise kaitiakitanga over the lake. The zone committee does not believe there is sufficient information to warrant making field investigations a permitted activity.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>6.7 Control Black Swans and Canadian Geese Numbers</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Fish and Game, landowners and Wairewa Rūnanga be encouraged to lower numbers of Black Swans on the lake.</p> <p>Landowners, Wairewa Rūnanga, Department of Conservation, Fish and Game, Federated Farmers, Environment Canterbury and Christchurch City Council should be encouraged to work together to manage Canadian Geese at lower numbers than currently present on the lake and its surrounds.</p> <p><u>Commentary</u> <i>It is estimated that waterfowl contribute in the order of 0.9-2.5% of phosphorus input into the lake. Consistent with the approach to reduce inputs of phosphorus the zone committee believes that it is important to reduce phosphorus input from waterfowl.</i></p> <p><i>The zone committee understands that Canadian Geese are no longer managed as game birds by Fish and Game and are not listed as a pest species in the current Regional Pest Management Strategy. There is no organisation that has ultimate responsibility for these game birds. The committee feels that it is important to encourage all landowners to take some responsibility along with agencies such as Fish and Game, Federated Farmers and councils to develop an action plan to lower numbers of Black Swans and Canadian Geese and to monitor, report and take further action as needed.</i></p>	

<p>6.8 Research - Changes in the Lake Ecology</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Wairewa Rūnanga, Environment Canterbury, Christchurch City Council, the Department of Conservation and researchers should develop a coordinated research programme that determines the effects of these recommended interventions on the aquatic ecosystems of the lake.</p> <p><u>Commentary</u> Refer recommendation 4.5 and 6.3</p> <p><i>A number of significant interventions have been recommended in this Addendum. Recommendation 4.5 suggests building on the monitoring programmes currently underway to track changes relative to the health of the lake and waterways, mahinga kai and the flood hazard.</i></p> <p><i>The zone committee believes that a research project should also be undertaken to track any changes in the aquatic ecosystems of the lake as they respond to the recommended interventions. Research is also needed to assess what other risk factors may be introduced (i.e. pests and weeds) with changes in the water quality of the lake. The research programme needs to acknowledge the overall lake ecosystem beyond a simple measure such as TLI.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>
<p>6.9 Promote the Lake as a Low Speed Recreation Area</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Councils, Wairewa Rūnanga and the community promote Te Roto o Wairewa as a low speed recreational resource.</p> <p><u>Commentary</u> Currently the water quality of the lake deters many from enjoying activities in or on the lake. Regular health warnings are published in summer when there is a cyanobacteria bloom; often giving the impression that the lake is in a poor condition much of the time.</p> <p><i>The zone committee hopes that as the water quality of the lake improves more people will come to enjoy the lake. More use should be encouraged but such activities should not negatively affect cultural and ecological values including threatened species habitats such as those of the crested grebe.</i></p> <p><i>The zone committee was aware that currently the New Brighton Power Boat Club runs approximately seven days per annum of racing on the lake. The committee recognises that changes that affect the use of the lake by the New Brighton Power Boat Club would need to occur during a review of the Navigation Safety Bylaw (scheduled for 2015) and that the Club would need to be consulted.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p>

<p>6.10 Management Plan – Te Roto o Wairewa</p> <p>The Banks Peninsula Zone Committee recommends that:</p> <p>Wairewa Rūnanga, Te Rūnanga o Ngāi Tahu, Department of Conservation, Environment Canterbury, Christchurch City Council, researchers and other agencies work together to develop a combined management plan for the lake.</p> <p><u>Commentary</u></p> <p><i>The Waitangi Tribunal recommended that a management plan for the lake be developed to improve the water quality of lake. The Tribunal envisaged that such a management plan would involve all parties with an interest in and responsibility for the lake and that the Crown would provide the same resources as recommended in respect to Te Waihora.</i></p> <p><i>The zone committee is supportive of this recommendation but believes that the first step is to better understand the processes behind the poor water quality of the lake; particularly the drivers behind the cyanobacteria blooms (refer recommendation 6.2). The committee also believes that further work on trialling some of the engineering solutions and assessing their effectiveness should be undertaken before making long-term commitments.</i></p> <p><i>The zone committee firmly believes that all parties need to work together to improve the water quality of the lake and that the Crown has a significant role to play.</i></p>	<p>Health of the lake/waterways</p> <p>Mahinga kai</p> <p>Flood mitigation</p>
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7.0 Timeline

SHORT TERM (now – 2020)	MEDIUM TERM (2020 -2025)	LONG TERM (2025 -)
4.1 Mauri –mahinga kai		
4.2 Flood risk		
4.3 More effective solutions		
4.4 Funding		
4.5 Monitoring and reporting programme		
5.1 Flood control		
5.2 Environment Plans - Manage sediment and phosphorus		
5.3 Inputs of phosphorus and lake assimilation <ul style="list-style-type: none"> Start now reduce by 2400kg P every 5 years (on the annual input of 11,300kg P) for 20 years 		
5.4 Flow allocation <ul style="list-style-type: none"> Water allocation by 2016 		
5.5 Minimum flows and lake levels <ul style="list-style-type: none"> Minimum flow regime by 2016 	5.6 Exclude all stock from waterways <ul style="list-style-type: none"> By 2020 	
5.7 Propagate poplar poles – soil conservation		
5.8 Promote indigenous biodiversity		
5.9 Wastewater treatment –phosphorus removal <ul style="list-style-type: none"> Protect septic tanks from floodwater – now Upgrade CCC system by 2020 		
5.10 Dissolved Oxygen - Waterways		
5.11 Monitor and adapt - Periphyton Growth		
5.12 Consent requirements – riparian and in-stream works		
5.13 Raise awareness and provide education opportunities		
5.14 Raise awareness – quality water supplies		
6.1 Lake opening – clarify objectives	6.2 Lake opening – engineering solutions	
6.3 Research - drivers of cyanobacteria blooms		
6.5 Engineering solutions – retention basin and wetlands <ul style="list-style-type: none"> Feasibility 2015 Operational 2020 	6.4 Engineering solutions – sediment and phosphorus legacy	
6.6 Enable Field Investigations		
6.7 Research –Lake ecology		
6.8 Control black swan and Canadian geese numbers		
6.9 Promote the lake as a low speed recreational area <ul style="list-style-type: none"> Review navigation safety bylaw scheduled 2015 	6.10 Management plan – Te Roto o Wairewa	

8.0 ADDENDUM - SUMMARY

ISSUES, OUTCOMES, PRINCIPLES, RECOMMENDATIONS and PATHWAYS

ISSUES	FLOOD HAZARD	MAHINGA KAI	HEALTH OF THE LAKE AND WATERWAYS
DESIRED OUTCOMES	FLOOD HAZARD Risks of flooding are known and understood The flood hazard is reduced	CATCHMENT Sediment discharges into waterways are reduced All streams that flow into the lake are flourishing ecosystems reflecting mauri, kaitiakitanga and mahinga kai values	THE LAKE Te Roto o Wairewa is a nationally significant project showcasing outstanding environmental restoration Annual Average TLI = 4 within 20 years No more than 30% of water quality samples in a year have chlorophyll a levels above 20µg/l Chlorophyll a levels should not exceed 50 µg/l The lake supports mahinga kai and contact recreation all year round within 15 years
PRINCIPLES	Recognise Wairewa Rūnanga as a Leader Ki Uta Ki Tai (source to sea) Understand the biophysical system Avoid creating new or exacerbating existing problems Ensure flood mitigation and riparian management are mutually supportive Control inputs before removing the sediment and phosphorus legacy Develop partnerships Develop long-term commitments Monitor, review and adapt		
RECOMMENDATIONS	GENERAL 4.1 Mauri – Mahinga Kai 4.2 Flood Risk 4.3 More Effective Solutions 4.4 Funding 4.5 Monitoring and Reporting	CATCHMENT 5.1 Flood Mitigation and Sediment Control 5.2 Environment Plans - Sediment and Phosphorus 5.3 Inputs of Phosphorus and Lake Assimilation 5.4 Flow Allocation 5.5 Minimum Flows and Lake Levels 5.6 Exclude All Stock from Waterways 5.7 Propagate Polar Poles – Soil Conservation 5.8 Promote Indigenous Biodiversity 5.9 Wastewater Treatment 5.10 Dissolved Oxygen - Waterways 5.11 Periphyton Growth- Monitor and Adapt 5.12 Consent Requirements – Riparian and In-Stream Works 5.13 Raise Awareness, Provide Education 5.14 Raise Awareness – Water Quality Supplies	TE ROTO O WAIREWA 6.1 Lake Opening – Clarify Objectives 6.2 Engineering Solutions – Lake Opening 6.3 Research - Drivers of Cyanobacteria Blooms 6.4 Engineering solutions – Sediment and Phosphorus Legacy 6.5 Engineering Solutions – Retention Basin and Wetlands 6.6 Enable Field Investigations 6.7 Control Black Swan and Canadian Geese Numbers 6.8 Research - Lake Ecology 6.9 Promote the Lake as a Low Speed Recreational Area 6.10 Management Plan – Te Roto O Wairewa
PATHWAYS	Individual Action District Plan CCC Drainage infrastructure DOC Management and Operational Plans	Wairewa Mahinga Kai Cultural Park Integrated Catchment Plan Water Related Services Bylaw CCC Waste Water Infrastructure NZ Transport Agency Roadway Infrastructure	Integrated Catchment Plan Navigation Safety Bylaw Land and Water Regional Plan Council Long-Term Plans Te Roto o Wairewa Management Plan

APPENDIX 1

TECHNICAL REPORTS – REFERENCES

Full reports can be found at: <http://ecan.govt.nz/OUR-RESPONSIBILITIES/REGIONAL-PLANS/REGIONAL-PLANS-UNDER-DEVELOPMENT/WAIREWA/Pages/wairewa-research.aspx>

Report	Author	Main findings
Assessing unmonitored water use in semi-rural environments: an investigation into the Okana & Okutu river catchments, Little River, Canterbury	Jay Whitehead (Waterways Centre for Freshwater Management)	Average domestic water use in the study was high, at just over 580 l/person/day, compared to the New Zealand average of 160-260 l/person/day. The total amount permitted-activity water usage in the catchments amounts to 4.7 l/s across the two rivers. This amount of flow is small when compared to the river flow statistics.
Stream ecology in tributaries of Wairewa/Lake Forsyth	Dr Duncan Gray (Environment Canterbury)	Water quality in the Okuti and Okana can be characterised as having naturally elevated, and increasing Dissolved Reactive Phosphorus (DRP) concentrations The streams of Banks Peninsula generally, and the Wairewa/Lake Forsyth catchment specifically, vary in habitat quality primarily according to riparian vegetation and stock access along their length. Despite some poor and declining values in water quality parameters, the fish and invertebrate communities appear healthy. However, the importance of catchment and riparian vegetation to streams is apparent.
Lake Forsyth/Wairewa: a literature review	Dr Marc Schallenberg (University of Otago)	At present, the lake is in a poor (hypertrophic) condition. While the lake has undergone serious degradation, some ecological values persist, such as the moderately diverse fishery, the use of the lake by crested grebes, and the occasional presence of native macrophytes. A study carried out on shallow New Zealand lakes that have undergone rapid regime shifts from clear water to turbid states indicates that the land use intensity of the catchment of Lake Forsyth/Wairewa is consistent with a moderate to high probability of regime shifts.
Summary of catchment and lake options for consideration by community	Dr Tim Davie (Environment Canterbury)	Summary of all proposed options for the catchments split into four categories (lake inputs; in-lake; water allocation & fish passage). Each option is discussed for feasibility, cost and effectiveness
Sediment sources and interventions in the Wairewa catchment	Ian Lynn (Landcare Research)	Primary sources of sediment and places for remediation are: stream banks in valley fill deposits; on-slope erosion scars; collapsed tunnel gullies on south-eastern shoreline of lake.

Report	Author	Main findings
		Recommends: effective riparian management in valley floors to strengthen channel banks; oversow exposed erosion scars; revegetating south eastern shoreline; restoration of wetland at head of lake to filter sediments & nutrients; better management of stock crossings and table drain runoff for tracks & roads.
Bird populations on Lake Forsyth (Te Roto o Wairewa)	Professor Ken Hughey (Lincoln University)	A report to looking at the importance of the lake for bird populations. Concludes that: 1) the lake has a large number of birds and meets national and international importance criteria for wetlands; 2) water level is an important driver of bird populations and maintaining levels between 1.7 and 2.1 masl would suit most bird species; 3) bird species do contribute a significant amount of phosphorus to the lake and therefore control of Canada geese (and possibly) swans could be considered.
Feasibility for sediment retention basin and wetland at head of lake	Dr David Painter (DPC Ltd)	A report investigating feasibility of a sediment basin at the head of the lake. The report concludes: 1) a sediment retention basin is technically feasible at the head of the lake; 2) indicative costs of a combined sediment retention basin and wetland being around \$1M for a 5 ha wetland and \$0.4 – 0.8M for a 15 ha sediment retention basin (not including land purchase); 3) a “back of the envelope” estimate suggests a 10 ha retention basin could receive 60-75mm of sediment per year.
Phosphorus budget for Wairewa	Sean Waters (University of Canterbury)	15 months of measurements of lake inflows and coincident phosphorus concentrations. When put onto an annual budget there was approx 11,200kg input with 1,700kg leaving the lake (9,600kg retained in lake). 74% of P from Okana with over 80% of that coming in a single storm event. 430,000kg of P stored in sediment
Nodularia blooms in Lake Forsyth/Wairewa: the role of internal phosphorus loading	Dr Marc Schallenberg (University of Otago)	Analysis of DRP and other nutrient data show “a lack of strong evidence for substantial internal P loading ... in Nodularia blooms” Concludes that in-lake technological control of P isn't recommended without further study as can't demonstrate that it will affect Nodularia. Report also suggests an exceedance approach to bloom magnitude as a target.
Assessment of current consented water takes in Wairewa catchment and effect of different flow allocation regimes on in-stream ecology.	Dr Tim Davie and Dr Duncan Gray (Environment Canterbury)	Very few consented takes in catchment at present. Both the Okuti and Okana catchments are not fully allocated under either and pNES or LWRP scenario. It is recommended that the pNES flow allocation regime is adopted for the Wairewa catchments.
Assessment of practical options for on-farm sediment control measures for Wairewa catchment	David Hewson (Opus Consulting)	Taking the Lynn report and translating it into a series of practical on-farm measures that could be taken for sediment reduction.
Lake Forsyth/Wairewa sediment management: treatment options for river and stream sediment sources	Rob Blakely (Restorationz)	Practical solutions for reducing streambank erosion

