Wharemauku Stream

KĀPITI COAST DISTRICT COUNCIL

Wharemauku Stream Freshwater Ecological Baseline Study

Rev 0

9 December 2016



Document history and status

Revision	Date	Description	By	Review	Approved
REVA	07/04/2015	For Technical Review	GT	GB	GT
REVA	17/04/2015	For Client Review	GT	Council	MS

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
REVA	GT	17/04/2015	Council	Issued for Client Review.
REV0	AR	09/12/2016	Council	Issued as Final Report.

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Wharemauku Stream

Project no:	AE04811.10
Document title:	Wharemauku Stream Freshwater Ecological Baseline Study
Revision:	0
Date:	9 December 2016
Client name:	Kāpiti Coast District Council
Project manager:	Ailsa Robertson
Author:	Dr Gareth Taylor
File name:	I:\AENVW\Projects\AE04811\Deliverables (issued)\Ecology Reports\Reports\Wharemauku Stream Ecological Study Rev0.docx

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Contents

Executive Summary **1**
Important note about your report **2**
1. Introduction **3**
1.1 Background 3
1.2 Purpose and scope of report 5
2. Methodology **6**
2.1 Desktop Study 6
2.2 Study Sites 6
2.3 Stream Ecological Value assessment 11
2.4 Macroinvertebrates 12
2.5 Fish sampling 13
2.6 Data and Analysis 13
3. Results **15**
3.1 Water Quality 15
3.2 Macroinvertebrates 18
3.3 Fish 20
3.4 Stream Ecological Values 24
4. Discussion **27**
4.1 Ecological Values 27
4.2 Issues identified 28
4.3 Developments which affect the Wharemauku Stream 33
4.4 Recommendations for improving ecological values 34
4.5 Suggested Ongoing Monitoring 37
4.6 Summary 38
5. References **39**

Appendix A. SEV Scores
Appendix B. Macroinvertebrate Results
Appendix C. Fish Passage Assessment
Appendix D. 2002 – 2011 Wharemauku Stream MCI Data

Executive Summary

The Wharemauku Stream catchment is home to the Paraparaumu and Raumati Beach communities and has historical importance to tangata whenua. Potential impacts of flood protection works and urban and agricultural development on Wharemauku Stream is of interest to Kāpiti Coast District Council, Greater Wellington Regional Council, and Te Ātiawa ki Whakarongotai, as well as community groups such as Friends of the Wharemauku Stream, and Forest and Bird. These groups have all had input into the Wharemauku Freshwater Management Plan (FMP). The FMP was developed in consultation with the community with aims for sustainable management of the Wharemauku Stream in terms of clean water, a healthy ecosystem, recreation, and cultural values.

Jacobs was engaged by Kāpiti Coast District Council to evaluate the present ecological value of the Wharemauku Stream. We undertook the ecological assessment using a desktop assessment and using the Stream Ecological Valuation methodology, which was developed by an expert panel and is widely applied in New Zealand for resource consenting, State of Environment reporting and catchment management.

The study found that the Wharemauku Stream has been affected by agricultural and urban land use, and engineering for flood management. In addition, proposed developments have the potential to further compromise the Stream's ecological value. Aquatic habitat in the upper catchment was observed to be affected by rural land use which included stock access to the stream. Stock access has caused bank slumping, sediment deposition, removed riparian vegetation, and allowed microbiological contaminants to enter the stream. The lower catchment is urban and managed for flood risk. Flood management has resulted in lower Stream Ecological Valuation scores in the lower catchment where the stream is straightened, deepened and constrained by constructed stopbanks to contain flood flows. Dry weather water quality monitoring results were generally below ANZECC/ARMCANZ (2000) Guideline default trigger values but medians exceeded trigger values for some parameters, including Total Nitrogen. The stream has been shown to be able to support a wide range of fish species through a number of studies; however, physical habitat is degraded in many areas of the stream and there are opportunities for enhancement.

Key issues affecting stream ecosystem functioning are associated with physical disturbance, which has resulted in low riparian cover, and engineered channels, which have removed flow heterogeneity. These issues can be remedied through a range of options such as riparian enhancement, minor channel works and reviewing management activities which are also expected to improve water quality. These are discussed further in this report. We suggest that stream ecological monitoring following the methodology in this report continues on an annual to two yearly basis to identify any improvement or decline in stream ecosystem health, and to inform further sustainable management of the Wharemauku Stream.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to assess the Wharemauku Stream to determine its present ecological value and inform catchment management in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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1. Introduction

1.1 Background

The Wharemauku Stream is located on the Kāpiti Coast in the Wellington Region, and flows from the foothills of the Tararua Ranges to the sea at Raumati Beach (Figure 1-1 on the following page). The Wharemauku Stream catchment includes the communities of Paraparaumu and Raumati Beach. The stream has historically been an important part of the Kāpiti area, providing habitat for fish and birds, and it has influenced land used through past flooding. It also holds significance for tangata whenua, who had used the area for collecting food and grazing.

In present day, a number of land uses exist within the Wharemauku Stream catchment including commercial, industrial, urban residential development and farming. This has resulted in Wharemauku Stream becoming altered from a natural state by channel straightening to provide flood channels, installation of stormwater drains and piped inflows, construction of road crossings and clearing of vegetation to allow rural and urban development. All of these alterations are known to have adverse effects on aquatic ecology and historical values associated with the stream.

The three key parties responsible for the management and maintenance of the Wharemauku Stream are:

- Local iwi, who have a guardianship role under the Treaty of Waitangi. All consents in relation to the stream are passed on to the local marae, who have instigated and played an active role in the development of the Wharemauku Freshwater Management Plan (FMP)
- Kāpiti Coast District Council (Council), responsible for managing stormwater, flooding issues, maintenance of flood structures, and reserves along the stream. Council issues resource consents for land uses outside the streambed that may impact the Stream, such as earthworks and building developments
- Greater Wellington Regional Council (GWRC), responsible for managing water quality, riparian planting and education initiatives for the stream. GWRC is responsible for issuing resource consents for works that directly impact on the stream, such as removing gravel or changing the stream's course

In addition to these parties, local people and environmental groups take an active interest in the stream, including the local Forest and Bird, and Friends of the Wharemauku Stream and other groups who have undertaken riparian planting projects.

The community's vision for the Wharemauku Stream, captured in the FMP, is "*a stream that is a focal point for the Kapiti community, providing amenity while achieving improved biodiversity and reduced flood risk".* This project was conceived with this vision in mind, to firstly understand the instream ecological biodiversity, with an aim to meaningfully inform future improvements to achieve ecological benefits.

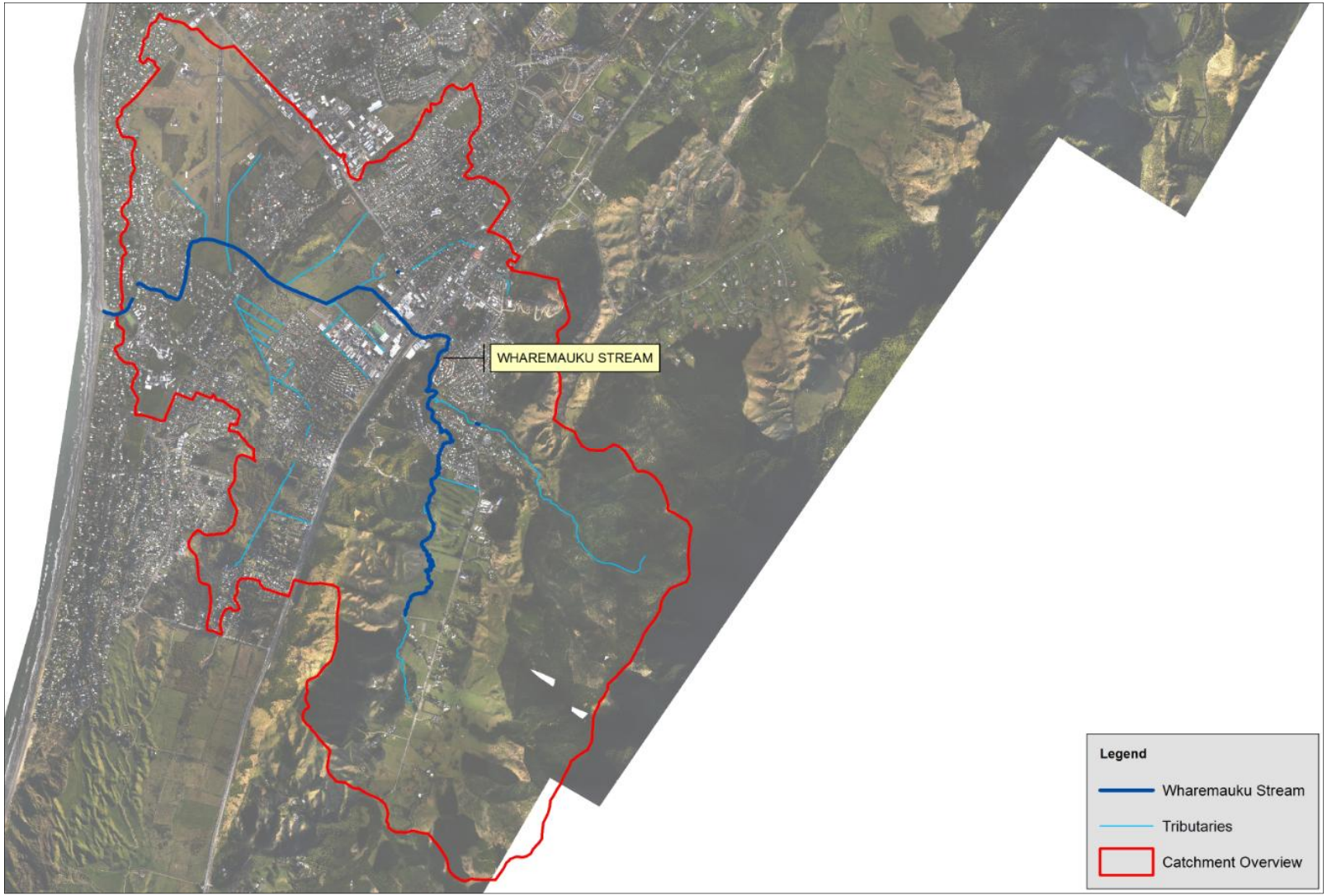


Figure 1-1: Wharemauku Stream Catchment (red outline).

1.2 Purpose and scope of report

The aim of this study was to obtain instream ecological baseline data which can be used to inform catchment management decisions, using a methodology that is repeatable for future assessments.

The purpose of this report was to evaluate the present ecological value of the Wharemauku Stream and identify actions to improve the ecological value of the Wharemauku Stream.

The following scope is included for this report:

- Conducting Stream Ecological Valuations (SEVs) at selected reaches on Wharemauku Stream
- Collection of sediment samples and testing for key contaminants
- Review and data analysis of water quality including comparison with relevant guidelines and standards applicable at the time of the survey
- GIS mapping
- Recommendations of implementations for the reach to increase ecological values and monitoring.

2. Methodology

2.1 Desktop Study

A desktop study was undertaken to collate present data for Wharemauku Stream relevant to this study. The data reviewed included that presented in recent resource consent applications, online GIS viewers, and monitoring reports. The NIWA Freshwater Fish Database was also reviewed for records of fish found with the Wharemauku Stream.

Jacobs currently undertakes a long-term water quality monitoring programme for Council in relation to their network stormwater discharges. As such no water quality samples were collected as part of this investigation as historical data were sufficient to identify water quality trends. Monthly dry weather sampling had been carried out since January 2014 at two sites on Wharemauku Stream: Weka Road LS and Hookway Grove CLS (Figure 2-1). Weka Rd LS is approximately 450 m downstream of the Airport site, and Hookway Grove CLS is approximately 300 upstream of the Kaitawa Reserve site. The monitoring is being undertaken to inform water quality limit setting in relation to the National Policy Statement for Freshwater Management. As this work is in progress the National Policy Statement for Freshwater Management limits have not been included in this report.

Dry weather sampling data were collated to identify trends in the stream's water quality against relevant guidelines. The following parameters are recorded for dry weather sampling:

- pH
- Dissolved Oxygen
- Dissolved Chromium
- Dissolved Copper
- Dissolved Zinc
- Total Nitrogen
- Nitrate Nitrogen
- Nitrite Nitrogen
- Total Kjeldahl Nitrogen
- Total Phosphorus
- Dissolved Reactive Phosphorus
- E. coli

In addition, proposed activities within the stream catchment were identified and considered for future management recommendations.

2.2 Study Sites

The scope of this study was focused on the main Wharemauku Stream branch where the Draft FMP is aiming to improve. Four sites were selected based on representativeness of land types in the catchment to reflect the differences in the types of disturbance along the stream.

The most downstream site was located at the airport where predominant features of the area are a straightened flood channel with managed vegetation and stopbanks. The second site was located at the confluence of Drain 3 and the Wharemauku Stream. The characteristics of this area are similar to that of the Airport branch, but improvements have been completed or are in progress, which make this site suitable to monitor increases in ecological value. The third site is located within the Kaitawa Reserve where the stream is more naturalised and riparian planting has taken place to improve the native vegetation cover. The most upstream site is located within farmland where stock access has not been restricted from the stream, resulting in very little riparian cover and high disturbance.

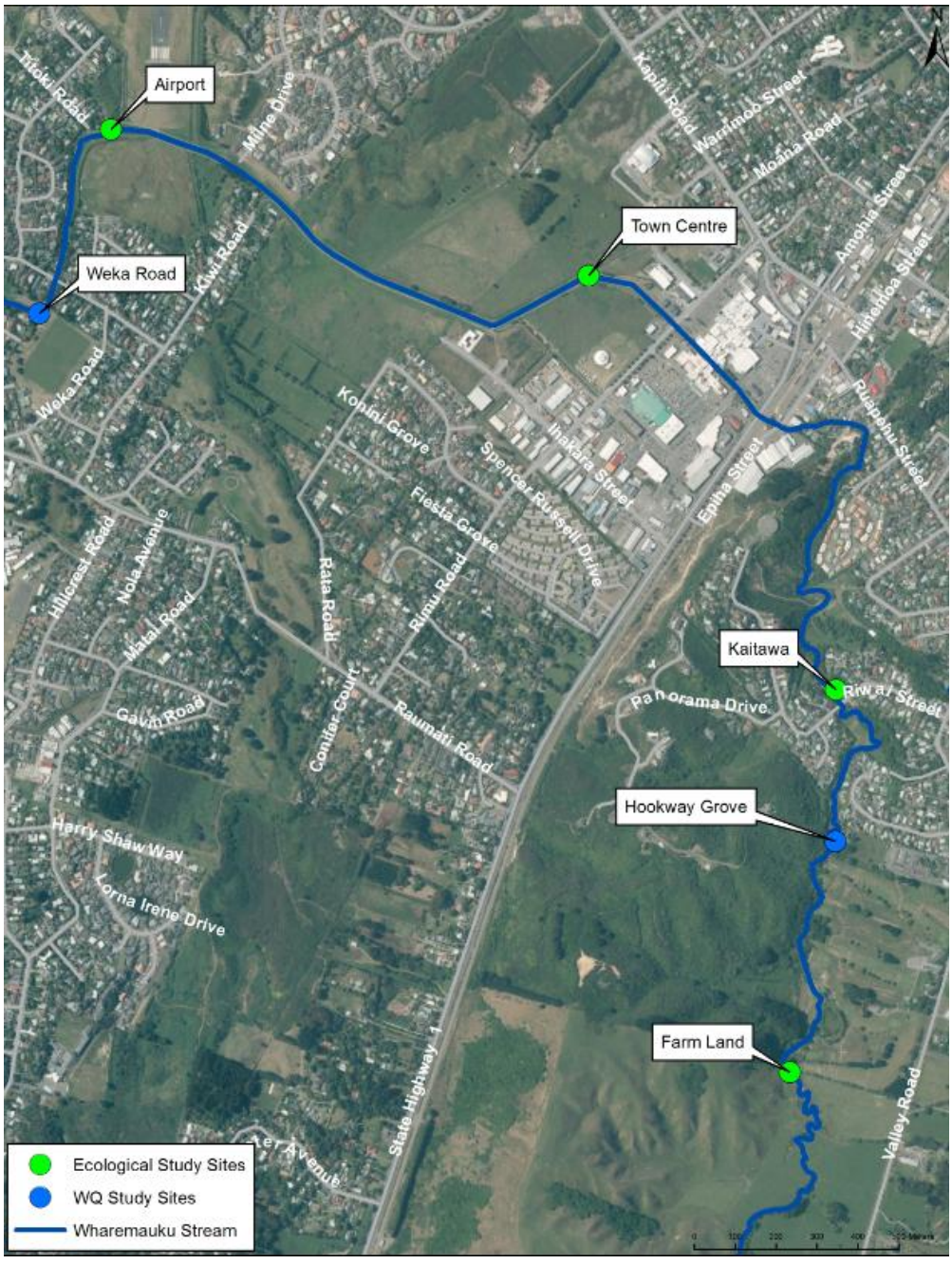


Figure 2-1: Location of study sites on the Wharemauku Stream.

Airport

The Airport site is located upstream of the Paraparaumu Airport runway and within the Airport to Coast reach of the FMP. The stream in this site has been highly modified from a natural state to include flooding stop banks and managed vegetation in the form of grasses. The stream channel at this location is approximately 2 metres (m) wide and 0.5 – 1 m deep. The connected catchment within this area is >25% impervious. The substrate in the channel was predominantly fine silts. At the time of the site visit the stream was in low flow and had high macrophyte (aquatic plant) cover. Riparian vegetation was not overhanging and consisted of long grasses and weed species.



Figure 2-2: The Airport site at Wharemauku Stream looking upstream (top) and in the stream channel (bottom).

Town Centre

The Town Centre site is located downstream of the Coastlands Mall area and is within the Town Centre /Coastlands stream reach in the FMP. The stream in this location is similar to the Airport site in that it is straightened and has stopbanks on the true left bank. The stream is approximately 1.5 m wide and 0.2 – 0.8 m deep. The substrate in this reach was made up of a mixture of fine sediment and cobbles. Vegetation in this site was taller and consisted of introduced grasses and weeds. It was noted that weeds were constricting the channel, which may prevent fish passage.



Figure 2-3: The Town Centre stream site looking downstream from the Drain 3 culvert.

Kaitawa Reserve

The Kaitawa Reserve site is located within the Kaitawa Reserve downstream of Riwai Street. In the FMP this is part of the Upper Catchment reach. The vegetation within this area was early successional, consisting of predominantly native trees and shrubs including flax (*Linum usitatissium*), toi toi (*Austroderia spp.*) and ferns (Pteridophyta). Exotic grass cover was outside of the 5 m riparian strip adjacent to the channel. Additional specimen plantings were also observed as recently planted. The channel substrate at this site was dominated by larger cobbles and gravel, and a large concrete box culvert was present upstream of the site. The channel here was between 1 – 3 m wide and 0.2 to 0.5 m deep.



Figure 2-4: The Kaitawa Reserve site looking at the stream within the reserve (top) and looking upstream within the channel (bottom).

Farmland

The Farmland site is located within farm paddocks upstream of the Kāpiti Golf Course on Valley Road and within the Upper Catchment reach of the FMP. The riparian zone in this location was dominated by pasture grass. There was no fencing, so stock had access to the stream, and pugging and cow manure were observed within the stream channel. The stream channel was approximately 0.5 - 2 m wide and 0.2 - 0.5 m deep. The stream itself had a meandering channel with pools, riffles and runs. The channel substrate was largely made up of cobbles.



Figure 2-5: The Wharemauku Stream at the Farmland site looking down stream, showing evidence of historic bank slumping on the left. Inset photo shows pugging and cow manure in the stream bed.

2.3 Stream Ecological Value assessment

As the key purpose of this study is to provide a baseline of ecological information to inform management decisions and identify ongoing improvements and impacts on the Wharemauku Stream it was important that the methodology selected could be repeated by other scientists and returned consistent scores. With these criteria in mind, the method used to collect ecological information in this study was the Stream Ecological Valuation (SEV) methodology developed by Auckland Council using an expert panel. The advantages of using the SEV methodology are that it is rapid, repeatable, standardised, and consistent between surveyors. The outputs of an SEV also allow comparison between streams in a given region.

The SEV methodology is largely applicable to a number of streams and is now considered best practice for resource consenting in the Wellington Region. In addition it is used widely for State of Environment monitoring

and to inform catchment management. The SEV assessment (Storey *et al.* 2011) considers in stream habitat, fish, macroinvertebrates and riparian habitat. These can be classified into four functions: hydraulic; biogeochemical; habitat provision; and biodiversity. An overall SEV score is obtained by averaging these at an even weighting. Scores range from 0 to 1. As an indication, a native forest catchment stream that is generally not impacted by development scores a 0.9 and an urban stream impacted by development scores a 0.30.

The site assessment was undertaken on 9 December 2014 where physical variables and macroinvertebrates were collected. Fish sampling was scheduled to be undertaken on the 10 December 2014; however, a large rainfall of 61.6 mm occurred resulting in high flows, so a stand down period in accordance with the New Zealand Fish Sampling Protocols occurred to allow fish to recover in the reaches so sampling occurred on the 22 January 2015.

2.4 Macroinvertebrates

Macroinvertebrates were sampled using C2 (soft bottomed, semi-quantitative) methodology at the airport site and C1 (hard bottomed, semi-quantitative) methodology at Town Centre, Riwai and Farmland sites (Stark *et al.*, 2001). Macroinvertebrates caught were preserved in 70% Isopropyl alcohol solution before being sent to a laboratory for identification. Ryder Consulting Limited was engaged to identify and provide data on the samples to Jacobs.

The samples were processed for species identification and relative abundance using semi-qualitative protocols for P1: Coded abundance as outlined in the Ministry for the Environment sampling protocols (Stark *et al.* 2001). Coded abundance scores summarise the number of species as shown below.

Table 2-1: Coded abundance scores used to summarise macroinvertebrate data.

Abundance	Coded Abundance	Weighting Factor
1 – 4	Rare (R)	1
5 – 19	Common (C)	5
20 – 99	Abundant (A)	20
100 – 499	Very abundant (VA)	100
>500	Very very abundant (VVA)	500

2.5 Fish sampling

Fish sampling was undertaken on 22 January 2014, approximately six weeks after the initial macroinvertebrate and habitat data collection. This was due to high rainfall interrupting sampling and in accordance with the New Zealand Fish Sampling Protocols (Joy *et al.* 2013). The method of sampling used was electric fishing and was undertaken throughout the entire of each reach that was sampled for SEV scores. All data were recorded for fish species, length and number of individuals.

2.6 Data and Analysis

Water quality data has been kept on file by Jacobs and was collated to plot and identify trends in water quality within the Wharemauku Stream for the past year on dry weather monitoring. The data were plotted against the ANZECC 95% protection guidelines for the relevant parameter to identify how often these are exceeded. E.coli was compared with the Ministry for the Environment (MfE) Microbiological Water Quality Guidelines (MfE, 2006). As Council are currently undertaking monitoring for limit setting, water quality data have not been compared with limits in the National Policy Statement for Freshwater Management.

All field data that were collated was recorded in excel spreadsheets for analysis. The data collected as part of the SEV methodology was entered into an SEV calculator (SEV Calculator Wellington 16Oct12 updated) which has been adapted for the Wellington Region (Well IBI native). Fish data were entered into a Wellington fish IBI calculator to return scores that represent the region.

Macroinvertebrate data were then used to calculate the following scores:

- Number of Ephemeroptera, Plecoptera and Trichopetera (EPT) taxa.
- Percentage of the total number of EPT taxa.
- Macroinvertebrate Community Index (MCI).
- Semi-quantitative MCI (SQMCI).

EPT taxa are commonly known as mayflies, stoneflies and caddisflies which have lower pollution tolerance so are considered to be associated with higher quality habitats and good water quality. A high EPT score indicates that the environment has good habitat quality and water quality for invertebrates.

MCI scores are based on occurrence of macroinvertebrate taxa to determine the organic enrichment of a stream. Each taxon is scored between a 1 and 10 in relation to organic pollution tolerance (1=highly tolerant and 10 = highly sensitive). The site score is obtained with the formula below:

$$MCI = \left(\frac{Sum\ of\ taxa\ scores}{Number\ of\ scoring\ taxa}\right) \times 20$$

SQMCI uses the same approach to scoring taxa as MCI but weights how abundant each taxa is in in the community with the weightings shown in Table 2-1. A site score is obtained with the following equation.

$$SQMCI = \frac{\sum(Taxa\ coded\ abundance\ \times Taxa\ score)}{\sum Coded\ abundances\ for\ sample}$$

For the purposes of this study which contained a soft-bottomed stream the soft-bottomed MCI and SQMCI scores were used as derived by Stark and Maxted (2007). Each of these equations returns a score that reflects the quality of the stream as shown in Table 2-2.

Table 2-2: Interpretation of macroinvertebrate community index values from Stark and Maxted (2007).

Quality Class	MCI	SQMCI
Excellent	≥ 120	≥ 6.00
Good	100 – 119	5.00 – 5.99
Fair	80 – 99	4.00 – 4.99
Poor	< 80	<4.00

3. Results

3.1 Water Quality

Water quality monitoring at both sites has shown exceedances of ANZECC/ARMCANZ (2000) Guideline default trigger values on occasions for most parameters, but median values are typically below trigger values. Metal concentrations at both locations were low and below trigger levels on most sampling occasions. High metal concentrations typically only occur in areas with significant urban or industrial development, and are usually higher following rainfall (these were all dry weather samples).

Median pH was around 7, or neutral, at both sites (Table 3-1). Dissolved oxygen (DO) saturation was typically high at the Hookway Grove site, but was relatively low at Weka Road. Both pH and DO naturally vary through the course of the day, so spot measurements do not usually detect high and low values. However, the low DO saturation spot measurements at Weka Road do suggest that low DO could be an issue at this site. Low DO can be caused by industrial discharges of organic waste or excessive growth of aquatic plants (macrophytes), with the latter a more likely explanation at the Weka Road site.

Nitrogen concentrations were elevated, with ANZECC/ARMCANZ (2000) Guideline ecosystem-protection triggers exceeded for total nitrogen, ammoniacal nitrogen, and nitrate plus nitrate nitrogen (NOx). However, ammoniacal nitrogen concentrations were well below toxic levels on all occasions (Table 3-1). This means that nitrogen is present at levels that may encourage nuisance growths of aquatic plants and algae, but that they are not at levels that are toxic to biota. Median Dissolved Reactive Phosphorus levels were higher than the trigger values at both sites with all individual results also exceeding the trigger value.

Counts of the faecal indicator bacterium *E. coli* were typically low at the Hookway Grove site, but were often elevated at Weka Road (Table 3-1). *E. coli* counts are often elevated during and following heavy rainfall.

Table 3-1: Water quality data and exceedances of trigger values monitored in Wharemauku Stream. Red denotes where a median result has exceeded trigger value. Units are g/m³ unless indicated.

Parameter	ANZECC Default Trigger Value[1]	Individual Exceedances (Weka)	Individual Exceedances (Hookway)	Median Value (Weka)	Median Value (Hookway)
Dissolved Copper	0.00133	2	1	0.0006	0.00075
Dissolved Zinc	0.1515	1	2	0.003	0.001
Chromium	0.0033	0	0	0.0012	0.0012
Nitrogen (Total)	0.614	10	8	1.01	0.83
Ammoniacal Nitrogen	0.021 Protection level: 1.88 at 7.3 pH	7	1	0.115	0.01
Nitrate + Nitrate Nitrogen	0.44	5	7	0.415	0.525
Dissolved Reactive Phosphorus	0.01	12	12	0.0435	0.0265
Total Phosphorus	0.033	8	5	0.0875	0.0305
E. coli[2] *(cfu/100 mL)*	550 – Red 260 – Amber <260 - Acceptable	1 – Red 3 - Amber	0 – Red 2 - Amber	230	90

[1]ANZECC trigger levels are for lowland streams and 95 % species protection for copper and zinc.
[2]MfE Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas

Plots of water quality data for the first year of dry weather sampling show variations in water quality over time, but the dataset is too short to detect any meaningful changes over time (Figure 3-1).

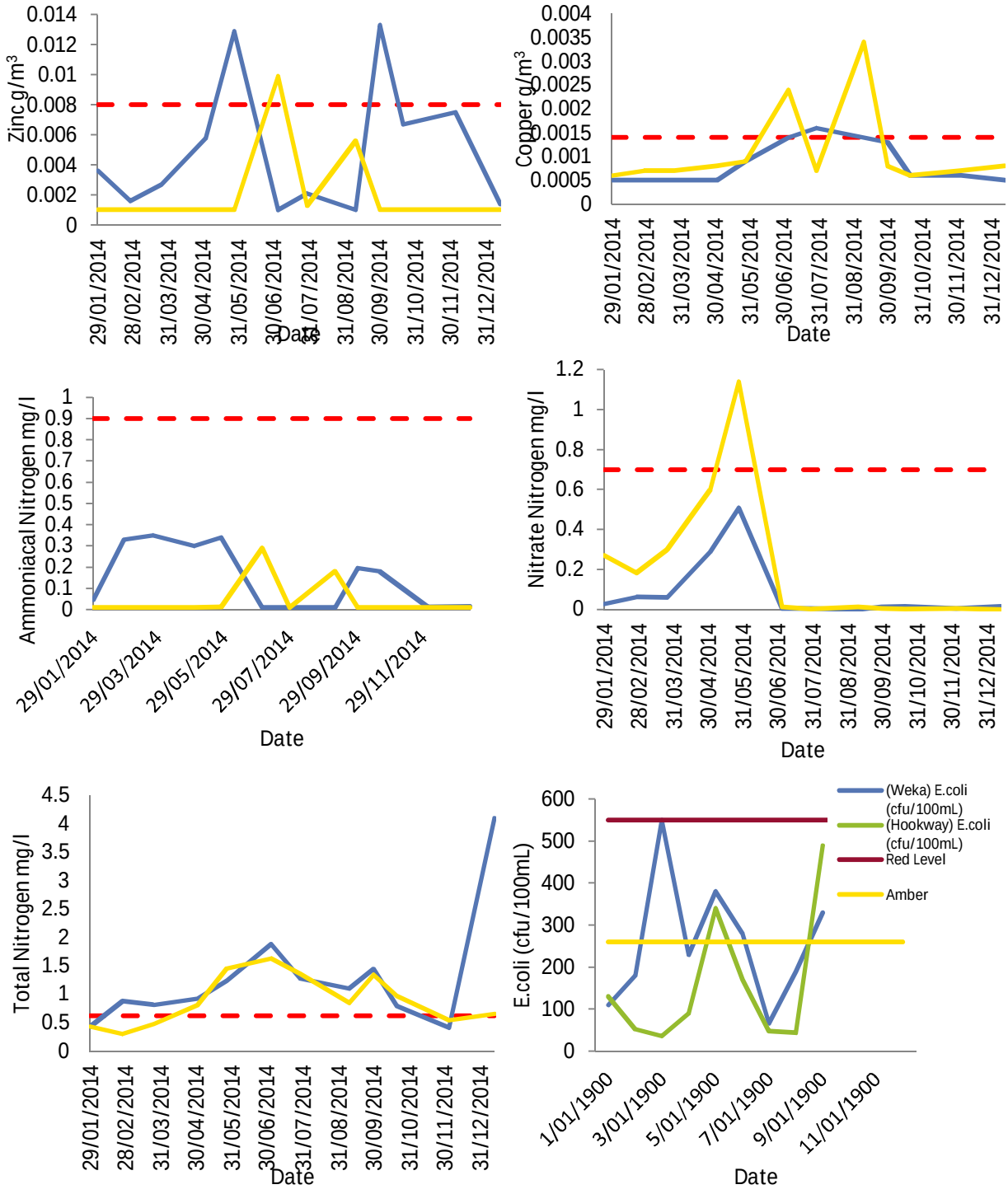


Figure 3-1: Water quality parameters monitored in Wharemauku Stream monitoring sites at Weka Road (lower catchment) (Blue) and Hookway Grove (upper catchment) (yellow).

3.2 Macroinvertebrates

In total 26 macroinvertebrate taxa were recorded in Wharemauku Stream, with taxa richness increasing from 9 at the most downstream Airport site to 19 at the most inland Farmland site (Appendix B). EPT taxa richness followed the same trend as overall taxa richness, increasing with distance upstream. Pollution-tolerant *Potamopyrgus antipodarum* snails and *Paracalliope fluviatilis* shrimps dominated at most sites. Larger numbers of Trichoptera (caddisfly) species were found in the upper catchment, though were in low abundance. No Plecoptera (stonefly) taxa were recorded in any samples.

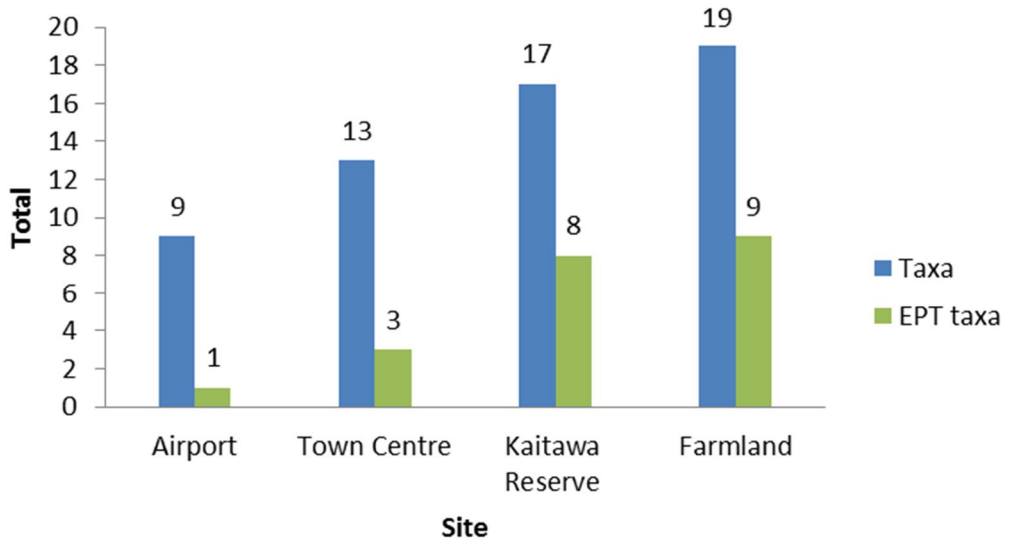


Figure 3-2: The total taxa and EPT taxa recorded in Wharemauku Stream.

MCI and SQMCI Scores

MCI scores generally followed the trend of improving (increasing) as sites that were located further up the catchment, but SQMCI scores were similar at most sites. The highest MCI score of 107 was recorded at the Kaitawa Reserve site, which categorises it as having good habitat and water quality, and the lowest score of 64 was recorded at the Airport site, which puts it in the poor category. The lowest SQMCI score was at the Farmlands site of 4.1 which is classed as fair, and the highest score was at the Kaitawa Reserve site at 5.2 which rates it as good (Figure 3-3). Unlike MCI scores that are based on presence-absence data, the SQMCI takes into account relative abundances of taxa found, and because abundances of sensitive species were low in the upper catchment, the scores were lower.

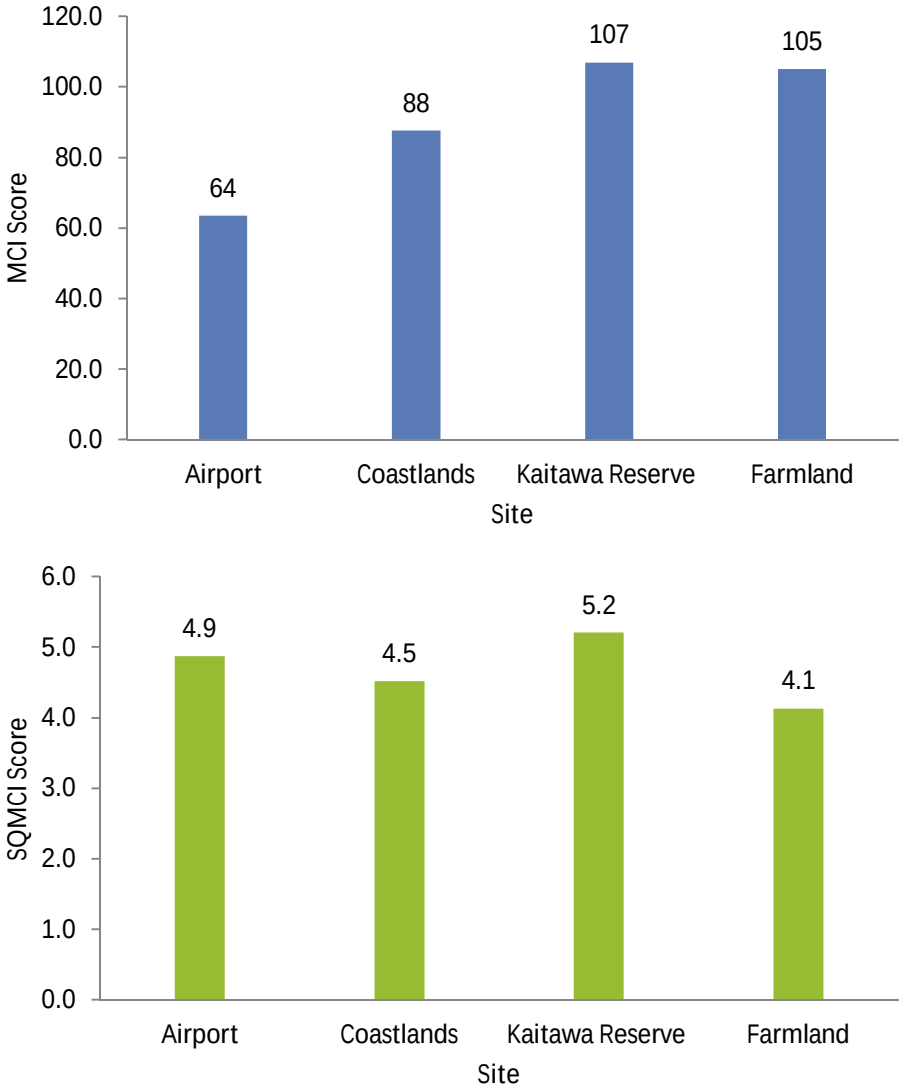


Figure 3-3: Soft-bottomed MCI and SQMCI scores for macroinvertebrates collected from Wharemauku Stream.

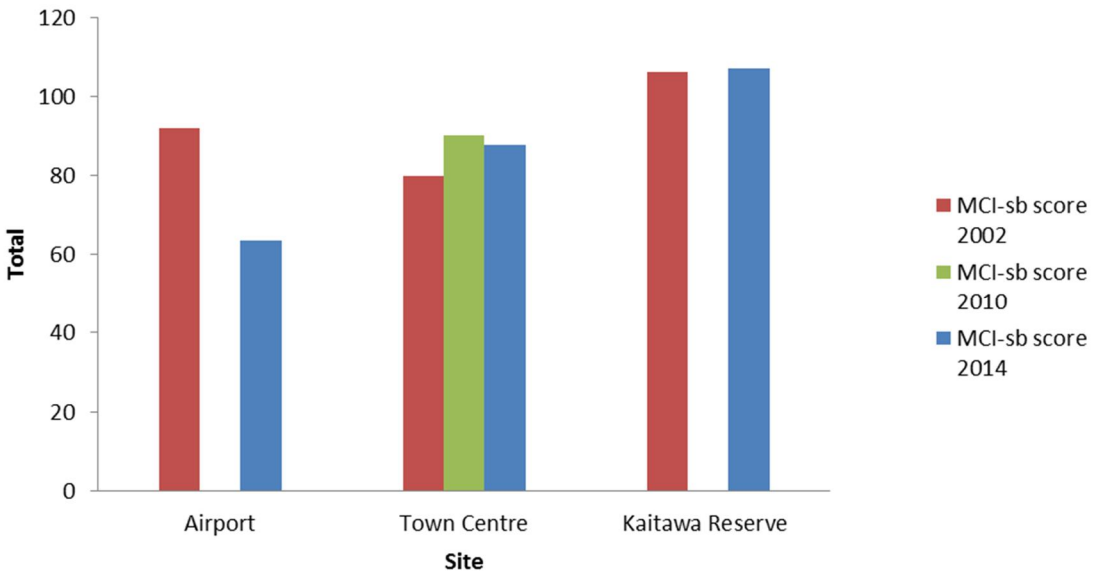


Figure 3-4: Soft-bottomed MCI scores for macroinvertebrates collected from Wharemauku Stream.

For the purpose of comparing past studies we have paired data from their sites to the nearby sites from previous studies and resource consent applications. When compared with previous MCI scores at sampling points taken near to the sites in this study no consistent trends over time are visible. However, it is notable that the Airport site has dropped from a previous rating of 'Fair' to 'Poor'. Kaitawa Reserve's score has remained largely unchanged and the Town Centre sites have been relatively stable. The source data and mapping for Figure 3-4 can be found in Appendix D.

3.3 Fish

The fish found in Wharemauku Stream sites largely consisted of common species to the Wellington Region (Table 3-2).

Table 3-2: Fish species and number found during sampling in Wharemauku Stream.

Species	Airport	Town Centre	Kaitawa	Farmland
Longfin Eel (*Anguilla dieffenbachii*)	1	1		
Shortfin Eel (*Anguilla australis*)	1	1		
Banded Kokopu (*Galaxias fasciatus*)			1	
Inanga (*Galaxias maculatus*)	50+ (adults)	3	2	
Common Bully (*Gobiomorphus cotidianus*)			2	1
Bluegill Bully (*Gobiomorphus hubbsi*)			1	1
Redfin Bully (*Gobiomorphus huttoni*)			3	2

Banded kokopu (Figure 3-5) were found in Kaitawa Reserve and these are listed in the Greater Wellington Regional Plan as being a Nationally Threatened Indigenous Fish recorded in the catchment. It is also worth noting that inanga, bluegill and redfin bully are all in the declining national threat status.



Figure 3-5: Banded kokopu found in Kaitawa Reserve.

In addition to fish found in the course of this survey, fish species recorded in Wharemauku Stream are shown in Table 3-3 below. Also predicted to be found in the Greater Wellington GIS viewer, but not recorded, are brown trout and giant bullies. Almost all these species are diadromous, meaning fish passage is required to allow them to migrate between the sea to complete their life cycle.

Table 3-3: Fish species previously recorded in Wharemauku Stream.

Species	**Photo**	**Conservation Status**[1]	**Source**
Yellow eye mullet (*Aldrichetta forsteri*)		Not Threatened	NZFFDB

Species	Photo	Conservation Status[1]	Source
Shortfin eel (*Anguilla australis)*		Not Threatened	NZFFDB Boffa Miskell, (2012)
Longfin eel *(Anguilla dieffenbachia)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)
Torrentfish (*Cheimarrichthys fosteri)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)
Giant kokopu (*Galaxias argenteus)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)
Koaro *(Galaxias brevipinnis)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)
Banded kokopu *(Galaxias fasciatus)*		Not Threatened	NZFFDB, Boffa Miskell, (2012)

Species	Photo	Conservation Status[1]	Source
Shortjaw kokopu *(Galaxias postvectis)*		Nationally Vulnerable	NZFFDB
Lamprey *(Geotria australis)*		Nationally Vulnerable	NZFFDB, Boffa Miskell, (2012)
Redfin bully *(Gobiomorphus huttoni)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)
Koura *(Paranephrops planifrons)*		At Risk - Declining[2]	NZFFDB
Common bully *(Gobiomorphus cotidianus)*		Not threatened	Boffa Miskell, (2012)
Smelt *(Retropinna retropinna)*		Not Threatened	NZFFDB, Boffa Miskell, (2012)

Species	Photo	Conservation Status[1]	Source
Inanga *(Galaxias maculatus)*		At Risk - Declining	NZFFDB, Boffa Miskell, (2012)

[1]Goodman *et al.* (2013)
[2]Grainger *et al.* (2013)
[3]Jowett & Richardson (2008)

3.4 Stream Ecological Values

The results from the SEV analysis showed that the Kaitawa Reserve site had the highest value of 0.68 whilst the other sites were considerably lower. The Airport site was the lowest scoring with 0.37 followed by the Town Centre site with 0.42 and the Farmland site with a score of 0.46.

The two downstream sites (Airport and Town Centre) had similar physical habitat characteristics due to high modification for flood conveyance, which has resulted in very little difference between scores. On the day of the site visit, the stream at the Town Centre site was observed to be choked with exotic weed species, which reduced its SEV score and can prevent fish passage. The Kaitawa Site had recently had riparian improvement works undertaken so obtained a higher score, whereas the most upstream Farmland site scored poorly due to stock access, no riparian cover, and highly disturbed banks. Table 3-4 shows the findings for the SEV survey with explanations of factors influencing the score, as well as a brief outline of the opportunities for improvement which is further discussed in Section 4.4. A full breakdown of SEV scores is provided in Appendix A.

Table 3-4: Scores for functions in the SEV survey and explanation of scores and improvements.

	Function	Airport	Town Centre	Kaitawa Reserve	Farmland
Hydraulic Functions	**Natural Flow Regime**	**0.33**	**0.25**	**0.30**	**0.65**
	Reason for score	Entire channel has been modified and contains unnatural loadings of fine silt.	Entire channel has been modified and has concrete lining on true right bank.	Contains Piped inflows indicating inputs of contaminants.	Has unnatural loading of fine silt and channel incision from flood flows
	Opportunities for improvement	Plant riparian zone and construct in stream pool, riffles and runs.	Plant riparian zone and construct in stream pool, riffles and runs.	Pipe inflows reduced.	Prevent stock access and riparian planting.
	Flood Plain Effectiveness	**0.26**	**0.20**	**1.00**	**0.04**
	Reason for score	Stopbanks reduce connectivity with flood plain and grass is mown so flow retention is low.	Stopbanks reduce connectivity with flood plain and grass is mown so flow retention is low.	Good riparian cover and high connectivity to flood plain.	Flood plain connectivity reduced by channel incision, very little riparian due to stock access
	Opportunities for improvement	Allow grass to grow larger or plant riparian	Allow grass to grow larger or plant riparian	None required	Prevent stock access and riparian planting.
	Connectivity to Natural Species Migrations	**1.00**	**1.00**	**0.30**	**1.00**
	Reason for score	No barriers present in reach	No barriers present in reach	Partial barrier at Riwai Street culvert in reach.	No barriers present in reach
	Opportunities for improvement	None required	None required	Improve fish passage (see Appendix B)	None required
	Connectivity to Groundwater	**0.60**	**0.65**	**1.00**	**0.83**
	Reason for score	Entire channel has been modified and contains unnatural loadings of fine silt.	Entire channel has been modified and has concrete lining on true right bank.	Natural channel lining and unmodified	Has unnatural loading of fine silt and channel incision from flood flows
	Opportunities for improvement	Reduce silt loading by planting riparian	Reduce silt loading by planting riparian Remove concrete lining if possible	None required	Prevent stock access and riparian planting.
Biogeochemical Functions	**Water Temperature Control**	**0.20**	**0.66**	**0.62**	**0.22**
	Reason for score	Poor riparian cover	Poor riparian cover but some shading from exotic weeds covering channel	Riparian cover is patchy due to early successional planting	No riparian cover, some shade given from high bank on true right of stream.
	Opportunities for improvement	Plant riparian to shade stream channel.	Plant riparian to shade stream channel.	Augment riparian to increase canopy cover.	Prevent stock access and riparian planting.
	Dissolved Oxygen Levels Maintained	**0.60**	**1.00**	**1.00**	**0.68**
	Reason for score	Some bubbles made when sediments disturbed indicating some areas of low oxygen in stream	No evidence of poor oxygen levels	No evidence of poor oxygen levels	Some bubbles made when sediments disturbed indicating some areas of low oxygen in stream
	Opportunities for improvement	Prevent fine sediment loading	None required	None required	Prevent fine sediment loading by preventing stock access.
	Organic Matter Input	**0.00**	**0.00**	**0.80**	**0.00**
	Reason for score	No riparian cover or evergreen tree cover to provide input	No riparian cover or evergreen tree cover to provide input	High proportion of riparian cover with native evergreen trees.	No riparian cover and very little evergreen tree cover to provide input
	Opportunities for improvement	Plant evergreen native trees to form riparian.	Plant evergreen native trees to form riparian.	Augment riparian to allow a full canopy of tree shading.	Prevent stock access and riparian planting with native trees.
	In-stream Particle Retention	**0.20**	**0.20**	**1.00**	**0.80**
	Reason for score	Channel is straitened and has moderate levels of macrophytes	Channel is straitened and has moderate levels of macrophytes	Channel is natural and has very low amounts of macrophytes.	Channel is natural but incised and has moderate levels of macrophytes
	Opportunities for improvement	Allow more channel heterogeneity	Allow more channel heterogeneity	None required	Prevent stock access and riparian planting.
	Decontamination of Pollutants	**0.67**	**0.52**	**0.82**	**0.60**
	Reason for score	High periphyton and moderate filtering by riparian	High periphyton and low filtering by riparian due to mown grass.	Low periphyton cover and high filtering from augmented riparian	High periphyton and low filtering due to grazed riparian
	Opportunities for improvement	Plant riparian or allow grass to grow longer.	Plant riparian or allow grass to grow longer.	Increase riparian density	Prevent stock access and riparian planting.
Habitat Provisio	**Fish Spawning Habitat**	**0.05**	**0.05**	**0.22**	**0.05**
	Reason for score	Low quality habitat due to steep banks and reduced riparian, lack of boulders	Low quality habitat due to steep banks and reduced riparian, lack of boulders	Banks are relatively steep but contain suitable riparian, lack of large boulders.	Flat banks but low quality riparian, lack of large boulders.

	Function	Airport	Town Centre	Kaitawa Reserve	Farmland
		and logs for bully species	and logs for bully species		
	Opportunities for improvement	Reduce bank steepness, plant riparian vegetation, add boulders/logs to stream.	Reduce bank steepness, plant riparian, add boulders/logs to stream.	Flatten banks, add large boulders.	Prevent stock access and riparian planting. Add large boulders/logs
	Habitat for Aquatic Fauna	**0.37**	**0.39**	**0.57**	**0.30**
	Reason for score	Low habitat diversity and flow heterogeneity due to straitened channels, low riparian integrity. Moderate shading in catchment but high impervious area coverage, low first flush control.	Low habitat diversity and flow heterogeneity due to straitened channels, low riparian integrity. Moderate shading in catchment but high impervious area coverage, low first flush control.	High habitat diversity and flow heterogeneity, higher shading and moderate impervious cover and moderate first flush flood control.	Moderate habitat diversity and flow heterogeneity, low shading and moderate impervious cover and moderate first flush flood control.
	Opportunities for improvement	Increase flow heterogeneity by adding boulders/logs to make low flow meander, plant riparian to allow flood control, add retention structures to catchment.	Increase flow heterogeneity by adding boulders/logs to make low flow meander, plant riparian to allow flood control, add retention structures to catchment.	Increase flow heterogeneity by adding boulders/logs to make low flow meander, plant riparian to allow flood control, add retention structures to catchment.	Prevent stock access and riparian planting.
Biodiversity Functions	**Fish Fauna Intact**	**0.67**	**0.67**	**0.97**	**0.83**
	Reason for score	Moderate species diversity	Moderate species diversity	High species diversity.	Moderate species diversity
	Opportunities for improvement	See comments for scores above.	See comments for scores above.	See comments for scores above.	See comments for scores above.
	Invertebrate Fauna Intact	**0.03**	**0.18**	**0.34**	**0.35**
	Reason for score	Low value taxa found and common in Wellington	Low value taxa found and common in Wellington	Moderate value taxa found, few EPT and mostly common in Wellington.	Moderate value taxa found, few EPT and mostly common in Wellington.
	Opportunities for improvement	See comments for scores above.	See comments for scores above.	See comments for scores above.	See comments for scores above.
	Riparian Vegetation Intact	**0.20**	**0.17**	**0.51**	**0.05**
	Reason for score	Riparian is managed and comprised of exotic mown grasses.	Riparian is managed and comprised of exotic mown grasses.	Riparian is regenerating and contains some piped inputs.	Riparian is grazed and disturbed and in poor condition.
	Opportunities for improvement	Plant riparian and reduce mowing.	Plant riparian and reduce mowing.	Evaluate options to remove piped inflows or apply treatment. Increase riparian cover.	Prevent stock access and riparian planting.
	Overall SEV Score	**0.370**	**0.424**	**0.675**	**0.456**

4. Discussion

Previous studies have shown that the stream does support a wide range of fish species, many of which have are considered at risk or threatened species. Land use in the catchment differs as the stream moves from the hills to the sea. The upper catchment is a mixture of native bush sections and farmland, which then grades into reserves with regenerating riparian vegetation. Finally the stream runs through urban areas and this is where large modifications have occurred which adversely affect ecological values (e.g. channel straightening, stormwater runoff, and minimal riparian cover). Planned developments, such as the McKays to Peka Peka expressway, adjacent to the stream further compromise the values of the stream. A range of options exist to improve the stream's ecological value, and these options largely relate to physical improvements, including riparian planting and altering channel characteristics. In addition, a focus on improving treatment and operational maintenance practices may also help to improve values.

4.1 Ecological Values

The results of this study found that in general sites within the Wharemauku Stream have been altered from a natural state which has influenced the values of the stream when applied to the scoring of SEV methodology. Water quality results showed that while nutrient and metal concentrations are typically non-toxic, nitrogen concentrations often exceed levels that promote excessive plant growth. This is particularly an issue for the lower catchment, where excessive weed growth is associated with low DO concentrations, which could adversely affect invertebrate and fish communities.

The ecological values of Wharemauku Stream are affected by a range of factors depending on adjacent and upstream land use. The lower reaches are surrounded by urban land use and are modified for flood protection. This has involved the straightening and deepening of channels and in some locations gravel extraction from the stream bed. Conversely further up the catchment the stream runs through a reserve and has had recent works to improve its ecological value through riparian planting. In this location the channels are natural and contain a range of habitat types for instream fauna. In the upper catchment the land use becomes rural and this has had impacts on the stream, with stock access disturbing the banks and removal of riparian which provides very little suitable habitat within the stream.

With regards to macroinvertebrates collected, a general trend was found that invertebrate taxa, EPT and MCI scores all increased as sites were located further upstream and SQMCI scores were relatively stable. This trend is not unexpected because MCI scores do not take into account the relative abundance of species. SQMCI takes this into account and found that more abundant pollution tolerant species were found in the lower reaches, whilst less pollution tolerant species were found in lower abundance in the upper catchment.

The Farmland site was considered to be or poor habitat quality due to a lack of riparian and stock access to the stream, which would have raised organic inputs through runoff and defecation. The location of the Farmland site was near to a reach which had a mixed native and exotic bush cover so it may be that macroinvertebrates were overlapping from this area raising the overall score for the site.

Macroinvertebrates were found in lower abundances at the farmlands site and hence returned lower SQMCI scores which take into account relative abundance; unlike MCI scores. Whilst this site does contain a range of Ephemeroptera and Trichoptera taxa, it was noted that many of these are the lower scoring taxa and in low abundance, indicating that the stream has degraded water quality or habitat condition which may prevent more sensitive taxa from inhabiting the area. In addition, no Plecoptera taxa (stoneflies) were recorded, which is common for sites with minimal native forest cover.

In general, the sites scored relatively poorly using the SEV methodology when compared to scores which can be obtained for streams within native forest catchments which score around 0.9. This was largely expected for the lower sites within the Wharemauku Stream, which are within the reach managed to reduce flood risk to the Paraparaumu and Raumati areas. This has resulted in the stream being straightened, deepened, riparian being mown, and stop banks constructed to contain flood flows. The Kaitawa Reserve site was considered to be significantly better largely due to improvement works that have occurred within the reserve to increase riparian condition. In contrast, the Farmland site further upstream was heavily impacted from stock access to the stream resulting in minimal riparian buffering and additional runoff and nutrients entering the stream.

4.2 Issues identified

The four sites evaluated had some common issues identified which impact on the Wharemauku Stream's ecological value and suitability as habitat for native fauna. The key issues identified within the Wharemauku Stream catchment include:

- Lack of riparian vegetation and canopy cover
- Low flow heterogeneity in lower catchment
- Aquatic weed choking channel
- High sediment loading
- Modified/incised banks
- Lack of suitable fish spawning habitat and fish passage restriction
- High impervious area within catchment
- Stock access in upper catchment

4.2.1 Lack of riparian and canopy

Riparian planting provides shading, temperature control, refuge for fish, input of food source, and interception and treatment of contaminants that flow over land into streams, in particular phosphorus and sediment. Shading is important to prevent the growth of periphyton and macrophytes, which can potentially smother the benthic environment of a stream, and shade also maintains temperature change. Stream temperature control is important because native species are not well adapted to handle extreme temperatures. The input of leaf matter to streams is also required because stream ecosystems have low primary production so rely on allochthonus

(external) inputs to support stream communities. With respect to scoring in the SEV methodology and New Zealand streams, evergreen trees are considered preferential due to providing continuous inputs when compared to perennial species (*Pers Comms.* Richard Story, NIWA).

In the upper catchment, the Farmland site has grazed pasture adjacent which provides limited shade and habitat. This has also resulted in no interception of sediment and phosphorus generated on the farm land. In the Kaitawa Reserve area there has been re-vegetation projects which have planted riparian planting along the stream. This planting provides shade and leaf matter to the stream which helps to control temperatures and increase food supply for instream fauna. The immediate land use at the Kaitawa Reserve site is park-land and therefore some sediment and nutrients will be intercepted by the planting, but two piped inputs exist from Riwai Street and would have minimal treatment. However, it would be expected that the quality of the surface runoff from the reserve would be of better quality prior to treatment compared with the upstream farm runoff. In the Kaitawa Reserve biogeochemical SEV scores were higher as a result of regenerating riparian vegetation and ongoing management of the stream.

In the Town Centre and Airport areas there is limited riparian vegetation. There is often long grass in the low flow channel which would provide some refuge for fish when allowed to overhang. A lack of riparian vegetation can reduce inanga spawning habitat in tidal reaches of the stream. Inanga spawning habitat has not been mapped within the stream; however, a larger number of adult fish have been observed in the lower catchment. However management practices such as mowing would reduce the ability of grasses to apply sufficient cover. There are few taller trees and shrubs to provide high shading or terrestrial inputs. Both sites also have no consistent buffer zone to provide treatment of overland runoff from adjacent grazed and urban land. In addition, little riparian and canopy cover has resulted in high exposure of the stream to sunlight resulting in a low thermal regularity function. Without temperature regulation, water is expected to have higher temperature fluctuations than for a shaded stream. A lack of riparian and overhanging vegetation is also unfavourable for instream fauna which often rely on fallen leaf matter as a food source, as well as terrestrial fauna which may fall into the stream.

4.2.2 Low flow heterogeneity in lower catchment

Flow heterogeneity is beneficial to stream ecosystems because the fauna has differing preferences for habitat types. For example, larger fish prefer pool habitats but small macroinvertebrates prefer riffle areas which are difficult for fish to forage. The Airport and Town Centre sites lower in the Wharemauku Stream catchment were observed to have been heavily modified for flood protection which included riparian clearance, straightened and deepened channels. This has caused low scores for functions which are influenced by these environmental conditions, including biogeochemical and habitat provision functions, as well as hydraulic functions which relate to flow heterogeneity.

4.2.3 Aquatic weed choking channel

Whilst aquatic plants can serve a beneficial function of shading the channel and providing habitat for fish and invertebrates, in excess they can result in channels becoming choked. Not only is this unwanted for managing flood risk, it also can prevent fish passage through choked reaches and depress DO concentrations to levels

that are harmful to fish and invertebrates. Whilst the stream flow was able to be maintained, high macrophyte cover can be unfavourable for instream fauna, particularly larger fish, which may need to migrate through the reach.

4.2.4 Fine sediment loading

Fine sediment loading is considered to be detrimental to stream health because it can clog areas which contain cobbles that macroinvertebrates such as mayflies live amongst. Fine sediment loading can displace such species and replace these with lower value species such as snails and chironomid worms and result in less diverse assemblages (Buendia *et al.,* 2013). In general, Wharemauku Stream contains gravel habitats but the lower reaches do have high sediment loadings.

The morphology of the Wharemauku Stream has two distinct differences within the catchment. The upper catchment though to the Town Centre site is a high energy hill stream with a predominantly greywacke geology. The bed of the stream is primarily gravel, and there is limited fine sediment. Gravel is naturally deposited in the Town Centre /Coastlands reach of the stream, where the stream grade suddenly becomes flatter and the stream velocity reduces. Council has consent to periodically remove gravel from the Town Centre reach of the stream, to maintain channel capacity for flood flow conveyance.

In the airport zone and further downstream the stream moves in to peat land and the stream has very low grade, and fine sediment is deposited. The fine sediment habitat found at the Airport Site is not considered to be beneficial for fish species which could potentially spawn in lower reaches. The fine substrate is likely to be naturally occurring due to the geology of the area but fine silts may be artificially entering the waterway due to urban stormwater inputs. Species such as inanga spawn outside the normally wetted channel in areas where vegetation is not covered by fine sediment. Therefore catchment management should aim to reduce fine sediment entering the stream by increasing riparian cover and treatment from the surrounding urban catchment.

4.2.5 Modified and incised banks

In the context of the SEV scoring system, banks that have low grade (<10°) are considered to be more ideal habitat. Banks with low grade banks provide spawning habitat for galaxiid species (e.g. inanga). These species spawn in low grade floodplain areas that are inundated in flood events that occur frequently and spring high tides. When banks become incised or steepened this reduces the available spawning habitat and is less beneficial for fish.

The lower catchment of Wharemauku Stream has been specifically engineered to enable greater flood flows to be conveyed and reduce flood risk to adjacent properties. In the Town Centre reach there is generally a two stage channel with a low flow channel and wider deeper flood channel within steep sided banks. In the airport zone and downstream the channel is further constrained and tends to have the form of a single steep-sided channel. Whilst flood risk has to be managed by Council there may be opportunities to provide lower grade channels and increase spawning habitat.

4.2.6 Lack of fish spawning habitat

In relation to fish spawning habitat there are two key requirements within New Zealand streams. Galaxiid species are known to prefer riparian areas which include low flat banks which are shaded and contain long grasses and/or vegetation which is rarely disturbed. Bully species require hard surfaces with boulders and logs to lay eggs on. The lower reaches of Wharemauku Stream are largely managed for flood risk which includes deepened channels and mowing the riparian zone. This has resulted in the riparian zone being highly unsuitable for fish spawning.

4.2.7 Fish passage

There are a number of structures within the Wharemauku Stream which may influence fish migration within the catchment. The culvert at Ruapehu Street is perched and provides a barrier to fish migration. There are also three large box culverts and the Coastland Weir that have previously had fish passage improved with the installation of boulder ramps to provide fish passage. However, a common issue with all of these sites is the shallow high velocity low-flow across the concrete bottoms of the culverts and weir. An evaluation of these culverts for fish passage along with recommendations have been made to retrofit selected structures (see Appendix C).

4.2.8 High impervious catchment cover

Impervious catchment cover is not beneficial for stream ecosystems as it results in an increase in contaminant inputs along with reduced flood attenuation for the catchment which can result in sudden flood events. In relation to the stream, Connected Impervious Area (CIA) refers to the percentage of impervious area that drains to the stream. In Wharemauku Stream CIA was between 25 and 30% was shown in a study (NZTA, 2010) to result in a significant decrease in the presence of macroinvertebrate taxa. This means that a higher degree of urbanisation (and higher percentage of CIA) will have a greater impact on the health and water quality of the stream.

In the Wharemauku, the part of the catchment upstream of Amohia Street, including the Kaitawa Reserve and farm land has an impervious area of less than 10%. The most built up areas of the catchment around Coastlands and downstream of the Airport Site have an imperviousness of greater than 25%. The majority of the catchment has an imperviousness of less than 25%, but these areas include land that is currently being developed as the McKays to Peka Peka expressway and the planned airport and town centre developments.

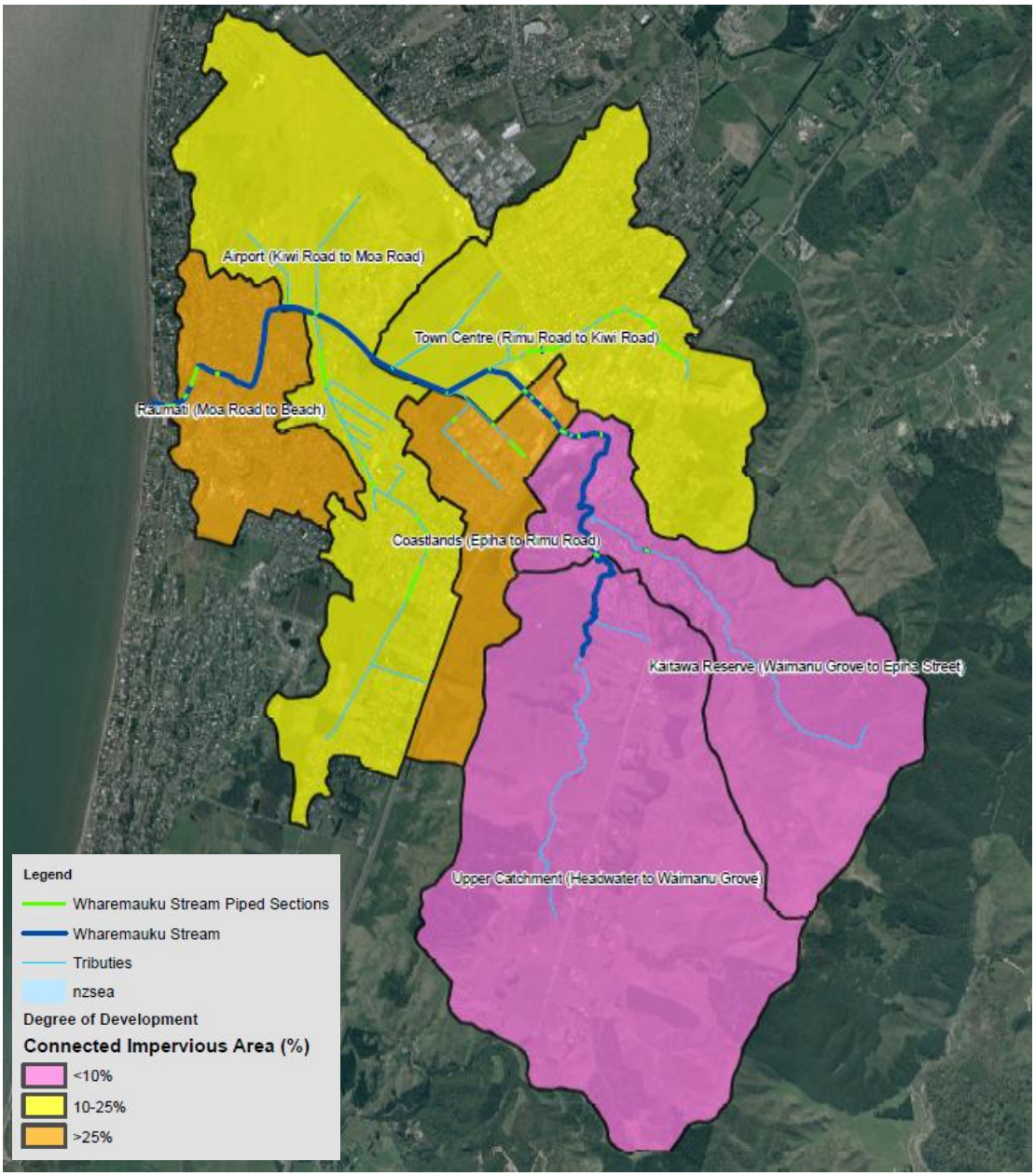


Figure 4-1: Degree of development within the Wharemauku Catchment

4.2.9 Stock access in upper catchment

Stock access is detrimental to stream health because it increases the inputs of sediment and nutrients, along with faecal contamination. This is often further exacerbated where stock are allowed to graze the riparian margins, removing the filtering function of riparian vegetation. At the time of the site visit the Farmland site had been heavily impacted by farming activity and including unimpeded access to the stream by stock. This has resulted in pugging of the stream banks, a bare riparian zone and defecation in or close to Wharemauku Stream. The physical nature of the stream channel was considered to be suitable for ecology due to the natural bed and meandering nature providing a number of flow conditions. However, the lack of riparian cover and

disturbance has been reflected in the SEV scoring for Biogeochemical and Habitat Provision functions which scored poorly for this site.

4.3 Developments which affect the Wharemauku Stream

There are currently a number of proposed developments which will have some effects on the Wharemauku Stream. These range from large-scale road projects for the McKays to Peka Peka Expressway, to town centre developments and airport runway extensions along with standard urban growth in the catchment. Currently the known activities predominantly affect the Wharemauku Stream Downstream of SH1 (Figure 4-2).

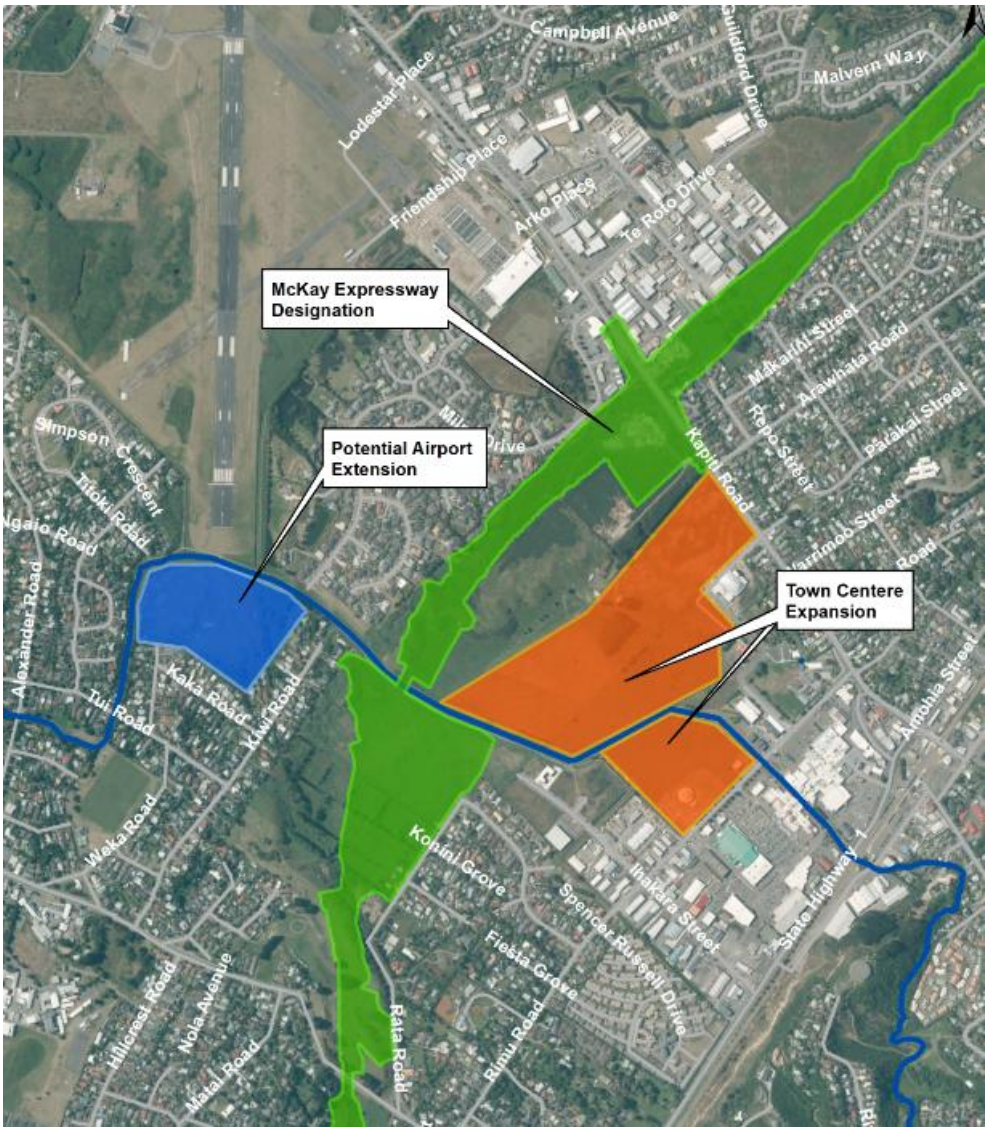


Figure 4-2: Indicative map of developments to take place in close proximity to Wharemauku Stream.

4.3.1 McKays to Peka Peka Expressway

The McKays to Peka Peka 4 lane expressway is 18.2km long and largely follows the Western Link Road designation. This project will cross the Wharemauku Stream near to the Kāpiti Coast Airport. The design

process for M2PP started in 2009 and has since gained resource consent with works underway. Construction began in late 2013 and is due for completion in mid-2017.

The works will result in the clearing of land and crossing Wharemauku Stream. This has the potential to result in disturbance to the stream bed in a localised crossing where the expressway passes over the stream. It is noted that there are consent conditions which require monitoring of the works (Conditions G.38A a(i)).

4.3.2 Kāpiti Town Centre Development

Currently the Kāpiti Town Centre is in the early stages of planning for increased development. This is largely linked to the McKays to Peka Peka Expressway, which will go through the area. The plans are currently in concept stages and are out for the community to comment. The plans include development in close proximity to the Wharemauku Stream with the Wharemauku Precinct which is conceptually to consist of commercial and residential development. This has the potential to impact on the stream due to increased stormwater runoff and higher potential for disturbance of the stream from public activity.

4.3.3 Airport runway

The Kāpiti Coast Airport is known to have intentions to extend its runway to allow it to serve larger aircraft. The extension of the runway which is located on the true right bank of the Wharemauku Stream will require the stream to be diverted or a large culvert for the stream in that section of stream. This will ultimately cause high levels of disturbance to the stream and has the potential to reduce its ecological value if effects cannot be mitigated sufficiently.

4.3.4 Urbanisation

It is expected that as the Kāpiti region grows urbanisation around the area will increase and additional developments may occur. Currently the lower reaches of Wharemauku Stream are urbanised but the upper catchment is in a mixture of pasture and native bush.

4.4 Recommendations for improving ecological values

A number of issues in the stream have been identified which largely are attributed to physical impacts that have occurred due to engineering to manage flood risk to the urban area and pastoral land use in the upper catchment. Whilst it is acknowledged that flood risk management is essential, recommendations are made which may be able to be implemented without increasing risk but will improve ecological values of the Wharemauku Stream.

Recommendations to enhance ecological value include:

- Improving flow heterogeneity in the lower reaches
- Riparian planting throughout the catchment
- Restricting stock access in the upper catchment

- Reducing the grade of banks in the upper catchment
- Increasing stormwater treatment to reduce contaminant loading
- Review of stream maintenance practices

4.4.1 Meandering low flow channels

In the straightened reaches of Wharemauku Stream the channel is hydraulically uniform and does not provide a variety of habitats for invertebrates and fish. To increase hydraulic heterogeneity it is recommended that modifications to the channel could be made to create mixed pool, riffle, and run habitat during low flow periods. It is understood that the flood channel must remain straightened to reduce the flood risk and that what is put in the low flow must not alter this.

Additions to the channel could include large bounders and logs to create pools and fast moving sections within the stream. Flood flows must be considered when designing and installing these due to the possibility of these becoming dislodged.

The tributaries of the Wharemauku Stream are predominantly engineered drains; they have potential to be modified to provide some pools and areas of refuge for fish. For example, the constructed wetland on the Drain 6 tributary on the Wharemauku near to Rimu Road is reported by Council officers to contain giant kokopu and large eels. The water velocity and flood risk associated with modifying the morphology of the tributary drains is less than potential risks within the main channel of the Wharemauku. Undertaking such works may be a suitable option for providing fish habitat if in-channel works in the Wharemauku are not feasible.

4.4.2 Riparian planting

Hydraulic modelling of the Wharemauku Stream has been undertaken to determine where riparian planting could be undertaken without increasing flood risk, including recommended plants and the locations for planting could be progressed without the need for any additional stream works. Council will work with community groups when progressing riparian planting of the Wharemauku Stream.

4.4.3 Restricting stock access in farmlands

During the site assessment it was noted that the Farmland site was highly impacted by stock and riparian clearing in an area adjacent to the stream. This part of the catchment would be expected to be able to support a diverse native ecosystem without disturbance. The physical structure of the stream provides a range of hydraulic changes which will support a wide range of invertebrates and fish. Without shading and reduced disturbance and nutrient inputs, high value pollution-sensitive species will not be able to inhabit the area unless the stream habitat and quality is improved.

It is recommended that stock access is restricted from the stream channel and that riparian planting is undertaken. However, it is acknowledged that negotiation would need to be had with the land owner to establish the width of buffer that will be allocated for riparian fencing and planting. The plants used should aim to provide

overhanging shade to the stream and taller successional trees planted out of the channel. If the desire it to get a canopy quickly, it is suggested that exotic species such a poplars are considered which will be removed when native canopy is established.

4.4.4 Reducing bank grade

As described above, the lower reaches of the catchments have been modified for flood risk and the upper catchment has incised channels which are not beneficial to fish spawning. In the lower catchment there is likely to be limited opportunity to undertake channel works due to the high cost of earthworks within the channel; however, in the upper catchment where the stream has been incised banks could be reshaped prior to riparian planting to reduce the grade and hence reduce the potential for further bank erosion.

4.4.5 Increasing stormwater treatment in catchment

When new development occurs there are provisions within Council's Subdivisional Guidelines to provide for water quality treatment and management of increases in stormwater runoff from new sites. Many developments have occurred in Kāpiti in the past 100 years. New developments have included stormwater treatment devices and in particular stormwater attenuation lakes, but older developments have not. The McKays to Peka Peka road construction includes stormwater treatment for all road runoff with the use of stormwater treatment devices including swales and wetlands.

Treating stormwater from existing urban areas is more challenging. Council, through its global stormwater discharge consents, monitors and investigates stormwater quality and proposes projects to improve water quality in high priority areas. Within the context of the Wharemauku Stream a review of the stormwater system may be required to identify where discharges with little or no treatment are occurring in ecologically vulnerable locations. Urban catchments often lack space to install large swales; however devices such as stormfilters may be more feasible. Stormfilters are inline systems which are known to remove a wide range of contaminants. Performance information for Stormfilters has shown that sediment laden influent can be treated to remove approximately 80% of suspended solids (Contech, 2007). Field tests were also conducted to evaluate removal of metals from influent and found that in general stormfilters were able to remove over 40% of metal concentrations (Contech, 2006).

4.4.6 Review of maintenance practices

Currently Council undertake a range of maintenance activities. Though not reviewed in detail, maintenance of the stream includes physical weed clearance and gravel extraction. Each of these can adversely affect the stream as the physical disturbance and chemical inputs can result in displacement of fauna which may migrate away from the area. It is recommended that practices are reviewed to determine an appropriate method to maintain the stream for flood risk which has minimal impact on the streams ecological capacity.

It is suggested that weed is controlled to be kept clear of the channel to allow clear migration passage. Currently the affected areas are within reaches which are found to be suitable for planting without increasing flood risk in

the catchment. Once cleared it may be possible to prevent weed growth back into the area by planting native species which occupy the space sufficiently to exclude such species.

4.5 Suggested Ongoing Monitoring

This baseline assessment was intended to establish a snapshot of the current state of the Wharemauku Stream. It is acknowledged that development has the potential to adversely affect the stream; conversely ongoing enhancements, such as riparian planting, have the potential to raise the stream's ecological value. Therefore ongoing monitoring is suggested especially if developments occur. It is also acknowledged that developments will have the responsibility of monitoring their impacts to ensure that they are not having detrimental effects. Improvements to the stream are also likely not to show significance within the SEV scoring within a year due to the small size of plantings and time for biota to migrate to the area. In addition, when looking on the scale of monitoring in the Kāpiti Coast District, it is unlikely to be feasible to undertake yearly surveys.

It is suggested that a full SEV is undertaken every two years at the same sites as in this study to re-evaluate stream values and identify further management requirements. If heavy development is occurring and is of concern to Council it is recommended that macroinvertebrate sampling is undertaken in conjunction with the water quality monitoring to identify if a reduction in diversity and scoring is occurring. If biological impacts are observed, then investigation should be made to identify the cause and appropriate actions to prevent further impacts occurring.

There are a number of delivery methods for monitoring due to the use of SEV methodology and its standardised nature. One option is to commission specialist scientists who are able to cover the full suite of work required. This will ensure quality is maintained and people with the appropriate qualifications undertake the work; however, it is acknowledged this may come at a higher cost than other options.

A second option is to engage a university student to undertake the work as a summer project and produce a report for Council. The benefits of this that a student will be relatively lower cost and could be supervised by a university professor ensuring the science is correct. This would require the contract to be issued through a university who would select a student to be paid as a scholarship. This method is currently undertaken by Environment Canterbury who currently engages summer students with Canterbury University.

A third solution is to combine both the aforementioned options and engage a student through a consultancy which will be supervised by a specialist for the course of the project. This will allow the consultancies quality systems to be used and provide a technically robust outcome which is of importance when recommending catchment management options.

If Council's preference is to complete this work "in house" it would require a staff member to be trained in the SEV methodology and ecology to complete the field work. Equipment may require purchase but costs are relatively low. It is also acknowledged that Council own an electric fishing machine which is the most expensive component of the field equipment.

4.6 Summary

Wharemauku Stream holds value to the local iwi but has undergone significant modification with urban and agricultural development. A number of developments are expected, such as large roading projects, which may further impact on the stream. The study found that the stream water quality was generally within the ANZECC/ARMCANZ (2000) Guideline trigger values/thresholds, and the catchment physical habitat characteristics resulted in lowered SEV and invertebrate index scores. This was largely attributed to riparian and channel modifications that has resulted in minimal riparian trees and shrubs and loss of the important functions that riparian zones serve.

Recommendations have been provided that aim to improve the physical habitat through increasing flow heterogeneity and riparian cover. Constraints associated with the urban catchment and flood risk will reduce the extent of works that are feasible; however, ecological improvement would still be expected and could be measured in ongoing monitoring. As the SEV methodology used for this study is repeatable and widely used this could be repeated over time through a number of mechanisms.

Overall, Wharemauku Stream has potential to support diverse ecological communities and it is anticipated that ongoing improvements in stormwater treatment, riparian management and physical habitat will improve the ecological values of Wharemauku Stream.

5. References

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Appendix A. SEV Scores

Function	Variable (code)	Airport	Towncentre	Kaitawa Reserve	Farmland
	Vchann	0.10	0.10	1.00	0.50
	Vlining	0.80	0.88	1.00	0.94
	Vpipe	1.00	0.70	0.30	1.00
Natural Flow Regime		**0.33**	**0.25**	**0.30**	**0.65**
	Vbank	0.52	0.40	1.00	0.20
	Vrough	0.50	0.50	1.00	0.18
Flood Plain Effectiveness		**0.26**	**0.20**	**1.00**	**0.04**
	Vbarr	1.00	1.00	0.30	1.00
Connectivity to Natural Species Migrations		**1.00**	**1.00**	**0.30**	**1.00**
	Vchanshape	0.20	0.20	1.00	0.60
	Vlining	0.80	0.88	1.00	0.94
Connectivity to Groundwater		**0.60**	**0.65**	**1.00**	**0.83**
	Hydraulic function mean score	**0.55**	**0.53**	**0.65**	**0.63**
	Vshade	0.20	0.66	0.62	0.22
Water Temperature Control		**0.20**	**0.66**	**0.62**	**0.22**
	Vdod	0.60	1.00	1.00	0.68
Dissolved Oxygen Levels Maintained		**0.60**	**1.00**	**1.00**	**0.68**
	Vripar	0.00	0.00	0.80	0.00
	Vdecid	0.00	0.00	1.00	0.10
Organic Matter Input		**0.00**	**0.00**	**0.80**	**0.00**
	Vmacro	0.54	0.98	1.00	0.86
	Vretain	0.20	0.20	1.00	0.80
In-stream Particle Retention		**0.20**	**0.20**	**1.00**	**0.80**
	Vsurf	0.74	0.83	0.85	1.00
	Vripfilt	0.60	0.20	0.80	0.20
Decontamination of Pollutants		**0.67**	**0.52**	**0.82**	**0.60**
	Biogeochemical function mean score	**0.33**	**0.48**	**0.85**	**0.46**
	Vgalspwn	0.00	0.00	0.45	1.00
	Vgalqual	0.00	0.00	0.75	0.00
	Vgobspwn	0.10	0.10	0.10	0.10
Fish Spawning Habitat		**0.05**	**0.05**	**0.22**	**0.05**
	Vphyshab	0.58	0.46	0.84	0.42
	Vwatqual	0.12	0.43	0.41	0.14
	Vimperv	0.20	0.20	0.20	0.20
Habitat for Aquatic Fauna		**0.37**	**0.39**	**0.57**	**0.30**
	Habitat provision function mean score	**0.21**	**0.22**	**0.40**	**0.17**
	Vfish	0.67	0.67	0.97	0.83
Fish Fauna Intact		**0.67**	**0.67**	**0.97**	**0.83**
	Vmci	0.03	0.29	0.50	0.49
	Vept	0.05	0.14	0.32	0.36
	Vinvert	0.00	0.10	0.21	0.21
Invertebrate Fauna Intact		**0.03**	**0.18**	**0.34**	**0.35**

	Vripcond	0.20	0.20	0.88	0.17
	Vripconn	1.00	0.85	0.59	0.30
Riparian Vegetation Intact		**0.20**	**0.17**	**0.51**	**0.05**
	Biodiversity function mean score	**0.30**	**0.34**	**0.61**	**0.41**
	Overall SEV Score	**0.370**	**0.424**	**0.675**	**0.456**

Appendix B. Macroinvertebrate Results

Macroinvertebrates found in Wharemauku Stream and the coded abundance as described in Table 2-1

TAXON	MCI score	MCI-sb score	Airport	Towncentre	Kaitawa Reserve	Farmland
COLEOPTERA						
Elmidae	6	7.2		C	A	A
CRUSTACEA						
Ostracoda	3	1.9	C	C	R	A
Paracalliope fluviatilis	5	5.5	VVA	VA	A	VA
Talitridae	5	5.5		R		
DIPTERA						
Austrosimulium species	3	3.9	R	C		
Chironomus species	1	3.4	R	C	R	R
Mischoderus species	4	5.9			R	
Orthocladiinae	2	3.2	C	A	A	C
Tabanidae	3	6.8			R	
Tanypodinae	5	6.5	R			R
Tanytarsini	3	4.5				R
EPHEMEROPTERA						
Austroclima species	9	6.5			R	R
Deleatidium species	8	5.6		C	A	C
Zephlebia species	7	8.8		R		C
MEGALOPTERA						
Archichauliodes diversus	7	7.3				R
MOLLUSCA						
Physa / Physella species	3	0.1		C		
Potamopyrgus antipodarum	4	2.1	VA	A	C	VA
OLIGOCHAETA	1	3.8		C	R	C
PLATYHELMINTHES	3	0.9	R			
TRICHOPTERA						
Aoteapsyche species	4	6.0		R	C	R
Hydrobiosis species	5	6.7			R	
Hydrobiosis umbripennis group	5	6.7			R	C
Oxyethira albiceps	2	1.2	R			R
Polyplectropus species	8	8.1			R	R
Psilochorema species	8	7.8			R	R
Pycnocentrodes species	5	3.8			C	R

Appendix C. Fish Passage Assessment

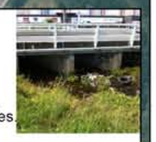
Coastlands Fish Pass



Current Status
- Fish passage rock ramp has improved access but the angle remains steep with visibly high water velocity.
- Exposed passage making fish vulnerable to predation from birds.
- Shallow water over concrete pad.

Recommended improvements
- Planting on stream edge with grasses to shade channel and provide cover from bird predation up fish pass.
- Consider constructing key passage channel on concrete pad with cover from birds.
- Consider adding byssus rope to help climbers.
- Concreting more rocks into the pass to create pooling areas and reduced flow velocity.

Epiha Street Culvert



Current Status
- Fish passage rock ramp has improved access.
- Wide shallow channel through the culvert which is not suitable for larger swimming species.
- Has high velocity flood flows with no refuge.
- Weed choking channel which may impede larger swimming fish.

Recommended improvements
- Clearance of weed and debris from in channel.
- Defining a narrow low flow channel within one culvert channel with refuge points for fish.
- Construction of a rock weir to raise water levels.

or
- Cement rocks/cinder blocks to provide narrower channel and fish refuge.

SH1 Culvert



Current Status
- Fish passage rock ramp has improved access.
- Wide shallow channel through the culvert which is not suitable for larger swimming species.
- Has a uniform velocity flow with no refuge pools for fish.
- Open and exposed providing little protection from predation.

Recommended improvements
- Defining a narrow low flow channel within one culvert channel with refuge points for fish.
- Increase weir height at outlet to raise water levels during low flow.

Ruapehu Road Culvert



Current Status
- Very small wetted margin within culvert only allows climbing species and few swimming species.
- Perched platform which only allows climbing species.
- Fast shallow flow with no refuge points which is unsuitable for many swimming species.

Recommended improvements
- Installation of baffles within culvert with spaced resting areas.
- A fish ladder from pool to apron and water level control on apron or build notched weir downstream of pool to raise water level above apron.

Riwi Street Culvert



Current Status
- Fish passage rock ramp and weir modification has improved access.
- Wide shallow channel through the culvert which is not suitable to larger swimming species.
- Has high velocity flood flows with no off line refuge (i.e. pools for fish to shelter).

Recommended improvements
- Construction of a rock weir to raise water levels.

or
- Cement rocks/cinder blocks to provide narrower channel and fish refuge.

Good Fish Passage

Good Fish Passage

Good Fish Passage

Good Fish Passage

N

CLIENT	KCDC
PROJECT	Wharemauku Stream Ecological Assessment
SCALE	1:6,000 @ A2
PROJECT CODE	AE04811
PROJECT MANAGER	GT
DRAWN	TN
PROJECT DIRECTOR	MS
DATE	17/04/2015

Wharemauku Stream
Tributaries and Drains
Stream Piped Sections
Roads

= Good fish passage, no improvement needed
= Partial fish passage, minor improvement needed
= Poor fish passage, improvement needed

Fish Passage on Wharemauku Stream

0 100 200 300 400 500 Meters

JACOBS SPATIAL
86 Customhouse Quay
Wellington
Tel +64 4 473 4265
Fax +64 4 473 3369

Date: 17/04/2015

I:\AENW\Projects\AE04811\Technical (controlled)\Spatial\GIS\2014 Mapping\Wharemauku Stream Fish Passage A3.mxd

Appendix D. 2002 – 2011 Wharemauku Stream MCI Data

Site		Wharemauku Stream													
		Cawthrone from WFP 2006					Boffa Miskell for M2PP								
Sample		Kaitawa	Coastlands - towncentre	Quarry	Coastlands Drain	Aerodrome	Wharemauku (site 6) - Towncentre			Lower Drain 7 Wharemauku (site 5)			Upper Drain 7 (site 4)		
Date		4-Apr-02	4-Apr-02	10-Apr-02	10-Apr-02	4-Apr-02	2-Dec-10	2-Dec-10	2-Dec-10	13-Apr-11	13-Apr-11	13-Apr-11	2-Dec-10	2-Dec-10	2-Dec-10
Taxa	Score														
Ephemeroptera															
Austroclima sepia	9	-	-	-	-	1	18	12	24	-	-	-	-	-	-
Deleatidium spp.	8	1	10	-	-	1	-	6	18	-	-	-	-	-	-
Plecoptera															
Megaleptoperla dimiuta	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Megaloptera															
Archichauliodes diversus	7	7	*	-	-	-	12	1	5	-	-	-	-	-	-
Hemiptera															
Sigara sp.	5	-	*	*	3	-	1	-	1	-	-	-	22	3	14
Anisops sp.	5	-	-	*	3	-	-	-	-	-	-	-	-	-	-
Odonata															
Xanthocnemis sp.	5	-	-	3	-	2	-	-	-	3	-	-	1	-	3
Coleptera															
Elmidae	6	85	22	-	-	-	-	420	396	-	-	-	-	-	-
Rhantus pulverosus	5	-	-	-	*	-	-	-	-	-	-	-	-	-	-
Diptera															
Austrosimulium spp.	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Chironomus zelandicus	1	-	1	3	131	-	1014	306	96	282	30	132	69	31	211

Site		Wharemauku Stream													
		Cawthrone from WFP 2006					Boffa Miskell for M2PP								
Sample		Kaitawa	Coastlands - towncentre	Quarry	Coastlands Drain	Aerodrome	Wharemauku (site 6) - Towncentre			Lower Drain 7 Wharemauku (site 5)			Upper Drain 7 (site 4)		
Date		4-Apr-02	4-Apr-02	10-Apr-02	10-Apr-02	4-Apr-02	2-Dec-10	2-Dec-10	2-Dec-10	13-Apr-11	13-Apr-11	13-Apr-11	2-Dec-10	2-Dec-10	2-Dec-10
Taxa	**Score**														
Eriopterini	9	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthodadinae	2	-	1	3	-	3	126	90	114	6	6	12	1		
Paradixa neozelandica	4	-	-	-	1	-	6	18	96	-	-	-	2	-	-
Polypedium sp.	3	7	-	-	-	-	-	-	-	-	-	-	-	-	-
Stratiomyidae	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanypodinae	5	3	-	-	2	-	84	-	12	396	48	114	7	2	27
Zelandotipula sp.	6	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Trichoptera															
Aoteapsyche spp.	4	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Hudsonema sp.	6	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hydrobiosis spp.	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Olinga feredayi	9	*	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxyethria albiceps	2	-	*	-	-	-	204	552	1146	-	-	-	-	-	-
Psilochorema sp.	8	6	-	-	-	-	1	1	1	-	-	-	-	-	-
Pycnocentrodes spp.	5	1	-	-	-	-	1	-	-	-	-	-	-	-	-
Triplectides obsoleta	5	1	-	-	-	-	-	12	2	4	-	-	2	-	4
Annelida	1	3	12	28	2	-	-	-	-	-	-	-	-	-	-
Neredae	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Hirudinea	3	-	12	28	2	-	-	-	-	-	-	-	-	-	-
Platyhelminthes	3	1	-	2	-	-	-	-	-	-	-	-	-	-	-
Mollusca															
Physa sp.	3	1	1	67	-	4	7	12	-	1	-	-	-	-	1
Potamopyrgus	4	69	51	58	-	722	4218	4212	7620	-	54	18	-	-	-

Site		Wharemauku Stream													
		Cawthrone from WFP 2006					Boffa Miskell for M2PP								
Sample		Kaitawa	Coastlands - towncentre	Quarry	Coastlands Drain	Aerodrome	Wharemauku (site 6) - Towncentre			Lower Drain 7 Wharemauku (site 5)			Upper Drain 7 (site 4)		
Date		4-Apr-02	4-Apr-02	10-Apr-02	10-Apr-02	4-Apr-02	2-Dec-10	2-Dec-10	2-Dec-10	13-Apr-11	13-Apr-11	13-Apr-11	2-Dec-10	2-Dec-10	2-Dec-10
Taxa	**Score**														
Antipodarum															
Crustacea															
Amphipoda	5	-	251	1	-	182	-	-	-	-	-	-	-	-	-
Ostracoda	3	-	-	52	-	15	198	120	102	72	6	18	253	32	440
Paratya curvirostris	5	-	*	1	1	3	12	30	6	-	-	-	-	-	-
Acarina	5	-	-	-	5	1	-	-	-	-	-	-	-	-	-
Collembola	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of taxa		**19**	**13**	**14**	**12**	**12**	**14**	**14**	**15**	**7**	**5**	**5**	**8**	**4**	**7**
%EPT		**42**	**15**	**7**	**0**	**17**	**8**			**0**			**1**		
MCI		**106**	**80**	**73**	**83**	**92**	**90**			**60**			**73**		
QMCI		**5.09**	**4.83**	**3.04**	**2.47**	**4.18**	**3.7**			**3.1**			**2.5**		

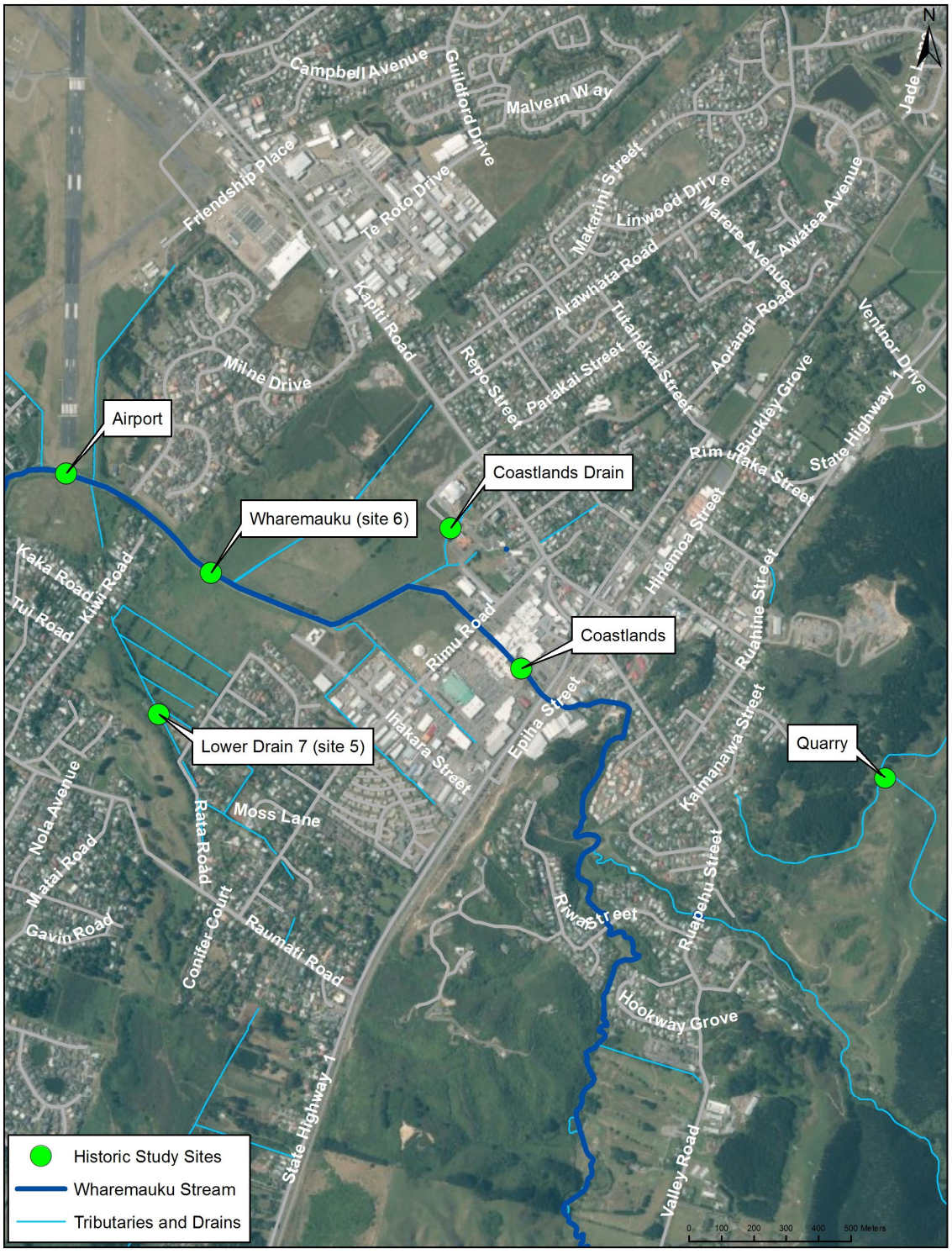


Figure 5-1: Wharemauku MCI Sites 2002 – 2011.