

# Waihou and Piako ecological monitoring 2013

Prepared by:  
Paul Franklin, Josh Smith, Glenys Croker  
(National Institute of Water & Atmospheric Research Ltd)

For:  
Waikato Regional Council  
Private Bag 3038  
Waikato Mail Centre  
HAMILTON 3240

April 2013

Document #: 2891970

Approved for release by:  
Dominique Noiton

Date February 2014

### **Disclaimer**

This technical report has been prepared for the use of Waikato Regional Council as a reference document and as such does not constitute Council's policy.

Council requests that if excerpts or inferences are drawn from this document for further use by individuals or organisations, due care should be taken to ensure that the appropriate context has been preserved, and is accurately reflected and referenced in any subsequent spoken or written communication.

While Waikato Regional Council has exercised all reasonable skill and care in controlling the contents of this report, Council accepts no liability in contract, tort or otherwise, for any loss, damage, injury or expense (whether direct, indirect or consequential) arising out of the provision of this information or its use by you or any other party.



## Waihou & Piako ecological monitoring 2013

Prepared for Waikato Regional Council

April 2013



**Authors/Contributors:**

Paul Franklin  
Josh Smith  
Glenys Croker

**For any information regarding this report please contact:**

Dr Paul Franklin  
Scientist  
Freshwater Fish  
+64-7-859 1882  
paul.franklin@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd  
Gate 10, Silverdale Road  
Hillcrest, Hamilton 3216  
PO Box 11115, Hillcrest  
Hamilton 3251  
New Zealand

Phone +64-7-856 7026  
Fax +64-7-856 0151

NIWA Client Report No: HAM2013-045  
Report date: April 2013  
NIWA Project: EVW13211

Cover photo: Banded Kokopu (P. Franklin, NIWA).

---

© All rights reserved. This publication may not be reproduced or copied in any form without the permission of the copyright owner(s). Such permission is only to be given in accordance with the terms of the client's contract with NIWA. This copyright extends to all forms of copying and any storage of material in any kind of information retrieval system.

Whilst NIWA has used all reasonable endeavours to ensure that the information contained in this document is accurate, NIWA does not give any express or implied warranty as to the completeness of the information contained herein, or that it will be suitable for any purpose(s) other than those specifically contemplated during the Project or agreed by NIWA and the Client.

# Contents

<b>Executive summary</b> .....	<b>5</b>
<b>1 Introduction</b> .....	<b>6</b>
1.1 Background.....	6
1.2 Study brief.....	6
<b>2 Methodology</b> .....	<b>7</b>
2.1 Sites.....	7
2.2 Fish.....	8
2.3 Macroinvertebrates .....	8
2.4 Macrophytes & periphyton .....	8
<b>3 Results</b> .....	<b>10</b>
3.1 Waihou catchment .....	10
3.2 Piako catchment .....	15
3.3 Habitat quality .....	23
<b>4 Discussion</b> .....	<b>25</b>
<b>5 Conclusion</b> .....	<b>27</b>
<b>6 References</b> .....	<b>28</b>
<b>Appendix A Field and habitat assessment forms</b> .....	<b>29</b>
<b>Appendix B Fish surveys</b> .....	<b>59</b>
<b>Appendix C Macroinvertebrate taxa list</b> .....	<b>69</b>
<b>Appendix D Macrophytes and periphyton</b> .....	<b>72</b>

## Tables

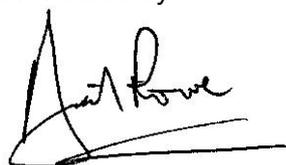
Table 2-1: Location of 2013 ecological monitoring sites.	7
Table 3-1: Results of 2013 electric fishing survey at the three Waihou catchment monitoring sites.	11
Table 3-2: Summary of macroinvertebrate results for the three Waihou monitoring sites in 2013.	13
Table 3-3: Summary of macrophyte indices for the three Waihou monitoring sites in 2013.	15
Table 3-4: Summary of periphyton indices for the three Waihou monitoring sites in 2013.	15

Table 3-5:	Results of 2013 electric fishing survey at the seven Piako catchment monitoring sites.	18
Table 3-6:	Summary of macroinvertebrate results for the seven Piako monitoring sites in 2013.	21
Table 3-7:	Summary of macrophyte indices for the seven Piako monitoring sites in 2013.	22
Table 3-8:	Summary of periphyton indices for the seven Piako monitoring sites in 2013.	22
Table 3-9:	Habitat assessment scores in 2013.	23
Table 4-1:	Proposed annual ecological monitoring sites for the Waihou and Piako catchments.	26

## Figures

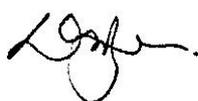
Figure 3-1:	Comparison between the relative abundance of fish captured in the 2009, 2011 and 2013 Waihou surveys.	12
Figure 3-2:	Comparison of MCI scores between survey years.	14
Figure 3-3:	Comparison between the relative abundance of fish captured in the 2012 and 2013 Piako surveys.	19
Figure 3-4:	Summary of fish length for the three most abundant fish species captured in the 2013 Piako fish surveys.	20
Figure 3-5:	Scatterplots of biotic indices against habitat score.	24

Reviewed by



Dr David Rowe

Approved for release by



Dr David Roper

Formatting checked by



## Executive summary

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato Region. WRC have initiated investigations in the Piako catchment to support and inform the review of water allocation limits in the catchment scheduled for 2014. The aim of this project was to build on the ecological monitoring carried out in the Piako catchment in 2012, and revisit a sub-set of monitoring sites in the Waihou catchment that were previously surveyed in 2009 and 2011.

The combined results of the 2012 and 2013 ecological monitoring surveys provide a valuable baseline assessment of the spatial patterns in aquatic communities across the middle and upper parts of the Piako catchment. The general pattern is for ecological communities to be more diverse and of a higher quality in less modified sites. However, the influence of catchment scale drivers, such as migration barriers, are also evident. Inanga were not recorded at any of the survey sites in the Piako in 2013. Whilst they were only present in low abundance at a few sites in 2012, their absence in 2013 should be noted and monitored in future. Inanga are one of the more sensitive native fish species and therefore are potentially valuable as an indicator species. A significant find during the 2013 survey was the population of banded kokopu in the Mangakahika Stream. This species is relatively rare in the existing fish records for the Piako catchment, thus this represents an important component of the catchment biodiversity.

Results of monitoring in the three sites revisited in the Waihou catchment showed relatively few changes in ecological communities. There was some evidence of a reduction in Macroinvertebrate Community Index (MCI) scores relative to previous years. In the absence of long-term monitoring it is not clear whether this is within the normal range of within site variability, or represents a departure from normal caused by low flows, for example.

Recommendations are made for establishing routine ecological monitoring, to be carried out on an annual basis, at five sites in the Waihou catchment and five sites in the Piako catchment. This will support development of more robust objectives for instream values and enhance WRC's ability to differentiate between natural variability and human induced changes to aquatic ecosystems.

# 1 Introduction

## 1.1 Background

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato Region. WRC's approach to the protection, allocation and use of water resources is set out in the Waikato Regional Plan: Variation No. 6 – Water Allocation (Waikato Regional Council 2012), which became operative on 10 April 2012. As required by the NPS for Freshwater Management (MfE 2011), the Plan defines minimum flows and allocation limits for all catchments in the region (Table 3-5; Waikato Regional Council 2012).

As a precursor to the review of flow and allocation limits in the Piako catchment scheduled for 1 July 2014 (Table 3-4A; Waikato Regional Council 2012), WRC have initiated investigations in the catchment to support and inform the review process. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems (MfE 2011). The aim of this project was to build on ecological monitoring initiated in the Piako catchment in 2012 (Franklin & Bartels 2012) and to revisit a subset of monitoring sites in the Waihou catchment previously monitored in 2009 and 2011 (Franklin & Booker 2009, Franklin et al. 2011). The results will contribute knowledge of the ecological values in the catchments to the water allocation decision-making process.

## 1.2 Study brief

The scope of this study was to undertake monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. The sites were to include repeat surveys at a minimum of two of the sites surveyed in the Piako catchment during 2012 and two of the sites surveyed in the Waihou catchment during 2011. In addition, up to six new sites were to be surveyed in the Piako catchment. The new sites were to encompass representative habitats from the main tributaries of the Piako, excluding the Topehaehae Stream.

## 2 Methodology

### 2.1 Sites

Monitoring was undertaken at ten sites (Table 2-1) in February 2013 during a period of drought. Repeat surveys were carried out at three sites in the Waihou catchment (Sites 3, 4 & 7) and three sites in the Piako catchment (Sites 5, 8 & 9). Four new sites were surveyed in the Piako catchment, two of which were on tributaries previously not surveyed (Sites 1 & 2) and two of which were located upstream of sites surveyed in 2012 (Sites 6 & 10).

**Table 2-1: Location of 2013 ecological monitoring sites.** \*Denotes new sites in 2013. Easting and northing given for downstream limit of survey reach (NZMG coordinates).

Site	Catchment	Stream	Easting	Northing
1	Piako	Mangakahika Stream*	2728975	6400407
2	Piako	Riuohauraki Stream*	2729470	6402548
3	Waihou	Paiakarahi Stream D/S	2751347	6429422
4	Waihou	Paiakarahi Stream U/S	2751431	6429122
5	Piako	Waitoa River	2742190	6365404
6	Piako	Mangapapa Stream*	2744443	6368529
7	Waihou	Karengorengo Stream	2758631	6384786
8	Piako	Waihekau Stream	2753911	6381502
9	Piako	Waitakaruru Stream	2727985	6377350
10	Piako	Piakonui Stream*	2741446	6371572

Site descriptions for Sites 3, 4 and 7 can be found in Franklin et al. (2011) and for Sites 5, 8 and 9 in Franklin and Bartels (2012). Sites 1 & 2 were located on tributaries draining the hills on the true left of the Piako, just north of Morrinsville. These new sites were selected primarily on the basis of filling a knowledge gap regarding fish populations in this part of the catchment. The lower reaches of both tributaries flow through relatively intensively developed dairy farming areas and are characterised by modified channel geomorphology (straightening and deepening of the channel), lack of riparian cover, proliferation of aquatic macrophytes, absence of woody debris, soft, silty substrates and degraded water quality. However, in the upper reaches of both tributaries native riparian cover remains relatively intact (although not continuous), and channel structure is more natural, meaning a greater diversity of habitats (pools, runs, riffles) are available. Additionally, substrates are more varied and include boulders, cobbles and gravel. Woody debris and instream cover is also present. Mean stream width at both sites was between 3-4 m.

The new monitoring site on the Mangapapa Stream (Site 6) was located upstream of a site previously surveyed in 2012. The aim of surveying a site further upstream for the 2013 survey was to increase coverage of fish records in the catchment and to survey a different habitat type. Stream width at Site 6 was approximately 3 m and mean depth 0.3 m. Substrate was dominated by boulders and cobble, with some bedrock in the upper part of the reach. There was some riparian cover present, but this was mainly dominated by bramble on the true right bank and exotic trees on the true left.

A new site on the Piakonui Stream (Site 10) was also surveyed in 2013. The aim was again to increase coverage of the fish records in the catchment, particularly within a native bush dominated stream. Site 10 has fully intact native riparian vegetation, a diverse channel structure and abundant instream cover in the form of boulders and woody debris. Due to the low flows at the time of the survey, surface flow was absent from one section of the reach, with water flowing below the substrate. Stream wetted width was about 3 m, but the active channel was about 6.5 m.

## **2.2 Fish**

Fish surveys were carried out by electric fishing using the standardised methods outlined by WRC (David & Hamer 2010). At each site, a 150m reach was surveyed by single pass electric fishing using an EFM300 with voltage adjusted dependent on local conditions. The number of each species captured, along with fish lengths were recorded for every 15 m sub-reach.

This survey approach is designed to maximise the likelihood of capturing the full diversity of species present by encompassing the full range of habitats present within a stream reach. Results are presented as relative abundance standardised by survey area (number of fish divided by total area sampled).

These abundance estimates are based on single pass electric fishing, which is a semi-quantitative method, and thus they are not equivalent to fish density and should not be used for comparison between sites. Interpretation of the relative abundance estimates are restricted to temporal comparisons at the same site, assuming that the same reach is sampled, with the same level of effort and sampling efficiency on each sampling occasion.

## **2.3 Macroinvertebrates**

Macroinvertebrate sampling was carried out following the standardised procedures for wadeable streams as outlined by WRC (Collier & Kelly 2005). In soft-bottomed streams, woody debris, macrophytes and stream banks were sampled, as appropriate, using a hand net (0.5 mm mesh) following MfE Protocol C2. For hard-bottomed streams, a kick-sampling approach targeting riffle areas and following MfE Protocol C1 was utilised. At each site the WRC REMS habitat assessment protocol was also carried out, with a Field Assessment Cover Form and a Habitat Assessment Field Data Sheet completed. All samples were preserved and returned to the laboratory for processing.

Samples were processed using the recommended MfE Protocol P2 (200 individual fixed count and scan for rare taxa). This provides proportional abundance data suitable for the calculation of most invertebrate parameters (Collier & Kelly 2005). Complete taxonomic lists were compiled and a range of community metrics calculated at the taxa level indicated in (Collier & Kelly 2005).

## **2.4 Macrophytes & periphyton**

Macrophyte and periphyton surveys were carried out following the standardised procedures for wadeable streams as outlined by WRC (Collier et al. 2006). At each of five transects located in the reach, periphyton cover was assessed at five points (10%, 30%, 50%, 70% and 90%) across the wetted width of the stream and the area of macrophyte cover occupying the 1 m wide band upstream of the transect was estimated. Details of the thickness and

cover of periphyton were recorded allowing calculation of the Periphyton Enrichment Index (PEI) and a range of periphyton biomass indices (Collier et al. 2006). The percentage cover of different submerged and emergent species of macrophytes was also recorded, allowing calculation of the macrophyte cover indices (Collier et al. 2006).

## 3 Results

### 3.1 Waihou catchment

#### 3.1.1 Fish

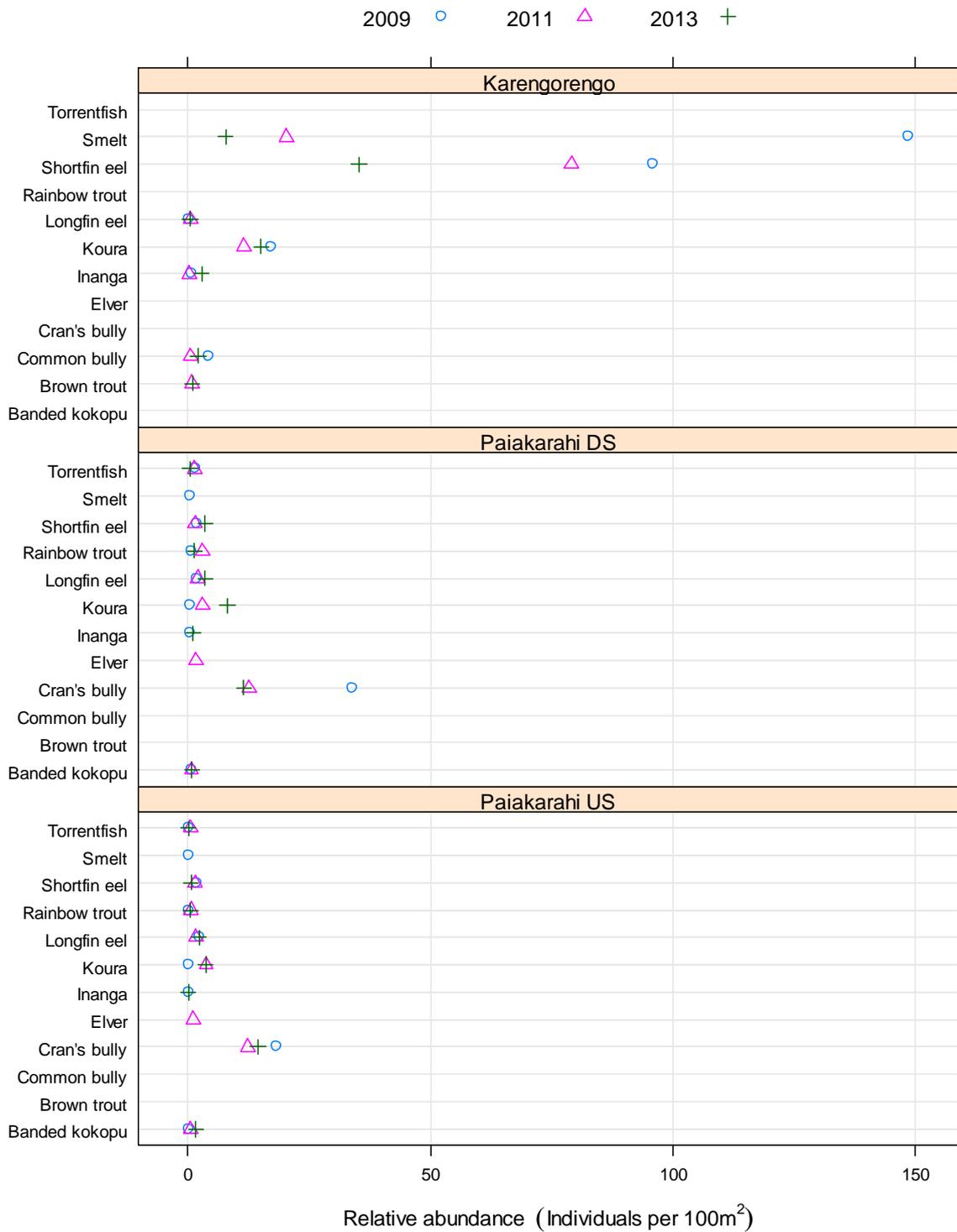
A total of ten different fish species were captured across the three sites in the Waihou catchment when re-visited during the 2013 survey (Table 3-1; Appendix B). Of the ten species, eight are native and the remaining two, brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*), are introduced. At all three sites, migratory species were present, including non-climbing species such as inanga (*Galaxias maculatus*), indicating the absence of any significant barriers downstream. The fish community of Karengorengo Stream was very strongly dominated by shortfin eel, with a number of both inanga and smelt (*Retropinna retropinna*) also present. At both sites on the Paiakarahi Stream, the dominant species was the non-migratory Cran's bully (*Gobiomorphus basalis*), followed by longfin eels (*Anguilla dieffenbachii*), shortfin eels (*Anguilla australis*) and banded kokopu (*Galaxias fasciatus*).

Each of these sites was first surveyed in 2009 and they have subsequently been surveyed biennially. Figure 3-1 compares the relative abundance of each species over time at the three sites. In the Karengorengo Stream, the relative abundance of smelt and shortfin eels in the survey reach was lower in the 2013 survey when compared to 2009 and 2011. A major contributing factor is likely to be the encroachment of emergent macrophytes in the stream due to the very low flows in 2013, meaning that capture efficiency during the 2013 survey was lower than on previous occasions. For other species at this site, there are no consistent patterns or significant differences in abundance between years. The brown trout that were first detected in the 2011 survey were still present in 2013. Species richness at this site is relatively high (6) for a lowland agricultural stream.

At the Paiakarahi sites, the relative abundance of each of the species has been relatively low and consistent between years and across the two sites. The main differences observed in 2013 are the lower abundance of torrentfish (*Cheimarrichthys fosteri*) at both sites, and the return of inanga, which were not recorded in the 2011 survey. There was also a slight increase in the abundance of banded kokopu at the upstream site relative to previous years. At both sites, the abundance of shortfin eels was relatively low, and dominated by smaller fish (<200 mm). Of note was the presence of a longfin eel population in the downstream site with a relatively low mean size (268 mm; range 120-650 mm). However, at the upstream site most of the longfin eels were >300 mm (mean 356 mm). At both sites Cran's bully (*Gobiomorphus basalis*) was the dominant species.

**Table 3-1: Results of 2013 electric fishing survey at the three Waihou catchment monitoring sites.** Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m<sup>2</sup>).

Site	Shortfin eel		Longfin eel		Cran's bully		Common bully		Torrentfish		Inanga		Smelt		Banded kokopu		Rainbow trout		Brown trout		Koura	
	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.
3. Paiakarahi Stream D/S	16	3.6	16	3.6	51	11.6	-	-	2	0.5	5	1.1	-	-	4	0.9	6	1.4	-	-	36	8.2
4. Paiakarahi Stream U/S	5	0.7	16	2.3	101	14.5	-	-	1	0.1	1	0.1	-	-	12	1.7	4	0.6	-	-	26	3.7
7. Karengorengo Stream	136	35.3	2	0.5	-	-	8	2.1	-	-	11	2.9	30	7.8	-	-	-	-	4	1	58	15.1



**Figure 3-1: Comparison between the relative abundance of fish captured in the 2009, 2011 and 2013 Waihou surveys.**

### 3.1.2 Macroinvertebrates

Sites 3 and 4 were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m<sup>2</sup> sampled at each site. Sampling at Site 7 followed MFE protocol C2 for soft-bottomed streams.

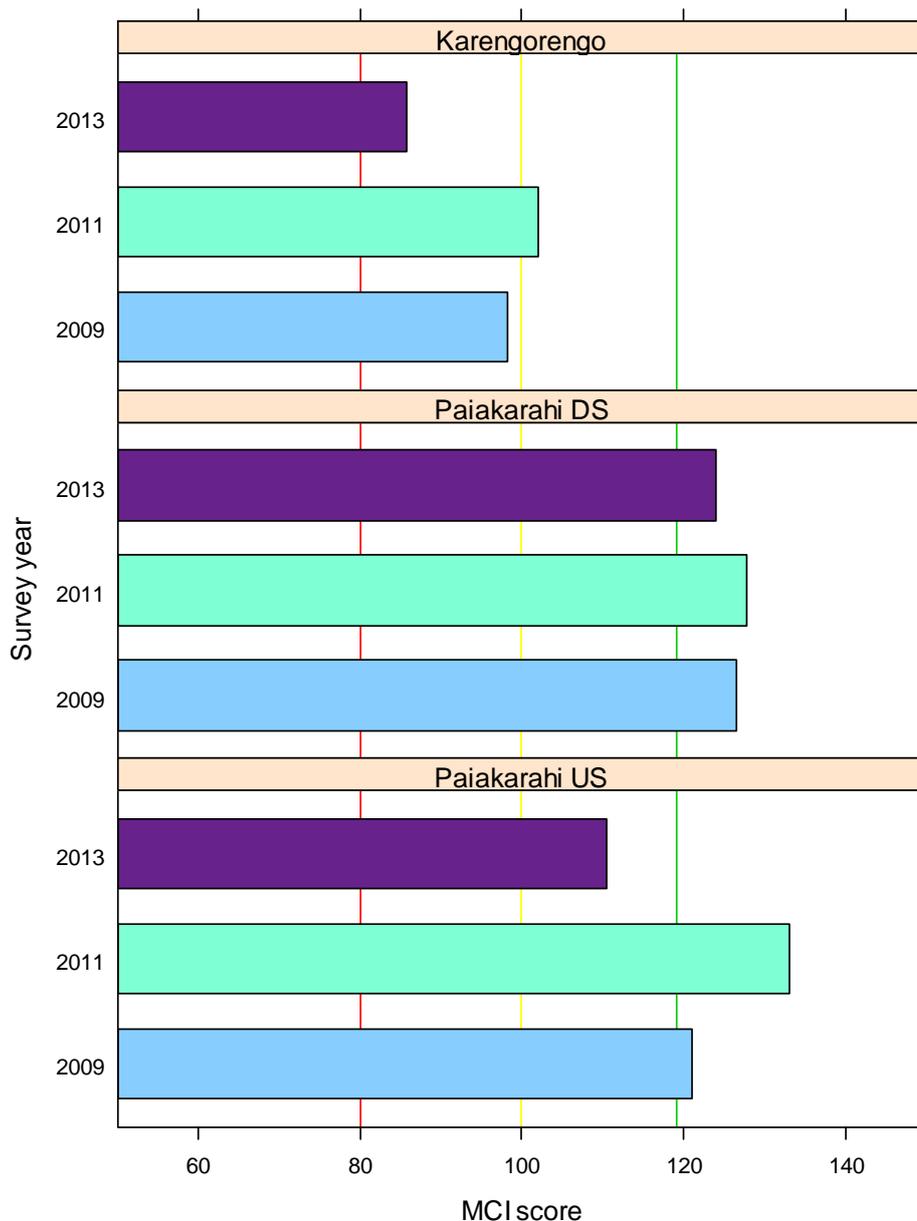
A full taxonomic list for each site is included in Appendix C and is summarised at the taxa level in Table 3-2 according to the methods of (Collier & Kelly 2005). Total taxa richness describes the total number of different types of macroinvertebrates present at a site. Broadly speaking, the higher the total taxa richness, the greater the quality and diversity of habitats present. The presence and abundance of taxa from the Ephemeroptera, Plecoptera and Trichoptera (EPT) orders is generally considered an indicator of good habitat and water quality. EPT richness and %EPT (Table 3-2) are used to summarise the presence and significance of these taxa at a site. The Macroinvertebrate Community Index (MCI) was originally developed to indicate the tolerance of macroinvertebrate communities to organic pollution in hard-bottomed streams. Scores of less than 80 are classified as poor, those of 80-100 as fair, those of 100-120 as good, and those of greater than 120 as excellent (Stark & Maxted 2007). Sites 7 was a soft-bottomed stream, and thus some caution must be applied to interpreting the MCI scores for that site.

Both total taxa richness and EPT richness was noticeably higher in Paiakarahi Stream (Site 3 and 4), compared to the Karengorengo Stream site. This reflects the differences in habitat between the stream sites, with the Paiakarahi Stream sites having a higher gradient, rocky substrates and intact native riparian cover, and the Karangorengo Stream site being a low gradient, agricultural stream. Interestingly, despite both having relatively high EPT richness (16), the two sites on the Paiakarahi Stream had quite different %EPT scores, with Site 4 being relatively low (27%). This appears to be a consequence of a lower abundance of the mayfly (Ephemeroptera) taxa that were present at this site. The MCI scores for Site 3 and 4 on the Paiakarahi Stream placed them in the Excellent and Good classes respectively. The reason for the slightly lower scores for Site 4, which is located upstream of the drinking water abstraction, as opposed to Site 3, which is in the impacted reach downstream of the take, is unclear. It may reflect differences in habitat between the two reaches associated with differences in stream size (Site 3 & 4 mean wetted width of 2.5 m and 6.0 m respectively). MCI score at the Karengorengo Stream site was 85.6, placing it in the Fair quality class, but it must be remembered that this was a soft-bottomed site where MCI scores are typically lower.

**Table 3-2: Summary of macroinvertebrate results for the three Waihou monitoring sites in 2013.**

Site	Total taxa richness	EPT richness	%EPT	MCI
3. Paiakarahi Stream D/S	25	16	63.6	124.0
4. Paiakarahi Stream U/S	27	16	27.2	110.4
7. Karengorengo Stream	14	6	28.1	85.7

Comparison of MCI scores between survey years shows a decline in score at all sites in 2013, but particularly at the Karengorengo Stream (Site 7) and the upstream site on the Paiakarahi Stream (Site 4) relative to 2009 and 2011 (Figure 3-2). The reason for these declines is unknown, but the low flows experienced during the summer of 2013 may be a contributing factor. The lack of a significant impact at the Paiakarahi downstream location (Site 3), may be due to the community already being adapted to the lower flows associated with the abstraction.



**Figure 3-2: Comparison of MCI scores between survey years.** Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007).

### 3.1.3 Macrophytes & periphyton

Macrophytes were not recorded at either of the sites in the Paiakarahi Stream. This largely reflects the dominance of rocky substrates at these sites, thus limiting the capacity for rooted macrophytes (Table 3-3). At Site 7, the abundance of macrophytes was relatively high in 2013, as reflected by MTC and MCC scores of 63%. This was significantly higher than the scores recorded for this site in 2011, when MTC and MCC were both 27%. The low flows experienced during the summer of 2013 are likely to be the cause of higher macrophyte cover. The dominant species was again *Nasturtium officinale* (Appendix D).

**Table 3-3: Summary of macrophyte indices for the three Waihou monitoring sites in 2013.** MTC = Macrophyte Total Cover; MCC = Macrophyte Channel Clogginess; MNC = Macrophyte Native Cover.

Site	MTC	MCC	MNC
3. Paiakarahi Stream D/S	0	0	0
4. Paiakarahi Stream U/S	0	0	0
7. Karengorengo Stream	63	63	4

Periphyton cover was relatively low at both sites in the Paiakarahi Stream and absent from the Karengorengo as a consequence of the sandy substrate (Table 3-4; Appendix D). The rocky substrates present in the Paiakarahi Stream make it suitable for the colonisation of periphyton. However, the relatively high level of shading and high proportion of bush cover in the catchment probably contribute to cover being relatively low. The Periphyton Slimyness Index (PSI) is more strongly related to some of the macroinvertebrate indices than the other periphyton indices (Collier & Kelly 2005). However, the values for PSI were relatively low in the Paiakarahi Stream sites. The abundance of periphyton was lower than that recorded in 2011 at both sites.

**Table 3-4: Summary of periphyton indices for the three Waihou monitoring sites in 2013.** PEI = Periphyton Enrichment Index; PFI = Periphyton Filamentous Index; PMI = Periphyton Mat Index; PPI = Periphyton Proliferation Index; PSI = Periphyton Slimyness Index.

Site	PEI	PFI	PMI	PPI	PSI
3. Paiakarahi Stream D/S	18.6	0	0	0	13.0
4. Paiakarahi Stream U/S	14.2	0	3.9	3.9	13.6
7. Karengorengo Stream	0	0	0	0	0

## 3.2 Piako catchment

### 3.2.1 Fish

Six different fish species were captured across the seven Piako monitoring sites during the 2013 survey (Table 3-5; Appendix B). Shortfin eel was the only species present at all six sites. Longfin eels were found at all sites except the Waihekau Stream (Site 8). However, it should be noted that the efficiency of the fish survey at the Waihekau site was extremely low due to excessive macrophyte cover (96%). Consequently, the 2013 results for this site should not be considered reliable. The abundance of both shortfin eels and Cran's bully was highest at the Waitoa River U/S survey site (Site 5) at 107 and 94 individuals per 100 m<sup>2</sup>

respectively. Torrentfish were only recorded at one site (Waitakaruru Stream) and only one individual was captured at that site. Banded kokopu were found at three sites (Sites 1, 2 & 10), including two of the new survey sites. At Site 1, the abundance of banded kokopu was high at 32 individuals per 100 m<sup>2</sup>, although it should be recognised that the majority of individuals here were new recruits (<70 mm). This species is uncommon in the fish records for the Piako catchment, therefore this is a significant finding.

As a result of the poor sampling efficiency at Site 8 in 2013, direct comparison between the results of the 2012 and 2013 surveys was only possible at Sites 5 & 9 (Figure 3-3). Results for all sites surveyed in 2012 and 2013 are included in Figure 3-3 for reference. At Site 5 (Waitoa River), the relative abundance of both eel species was similar between years. However, there was a significant increase in the relative abundance of Cran's bully in 2013, relative to 2012. This appears to be largely a consequence of recent good recruitment, with large numbers of bullies <40 mm recorded in the 2013 survey. In the 2012 survey, both torrentfish and inanga were present at this site in low numbers, but neither were present in 2013. The drought conditions in 2013, may have restricted the upstream passage or recruitment of inanga to the site and may explain their absence as an annual species. However, it is also possible that part of the reason for their absence at the site is a reduction in overhanging cover (preferred habitat) caused by cattle grazing close to and in the stream in 2013. At Site 9 (Waitakaruru), the relative abundance of all species was slightly lower in 2013, when compared to the 2012 results, but it is likely this is within expected levels of inter-annual variation.

The new site on the Mangapapa Stream (Site 6; Mangapapa 2 in Figure 3-3) had lower species richness than the site surveyed further downstream in 2012 (Mangapapa in Figure 3-3). The two species recorded at the downstream site, but absent from the new site were torrentfish and inanga. The difference is likely to be the consequence of a lack of suitable habitat at the 2013 site, and possibly restricted upstream passage under low flows. The new site on the Piakonui Stream (Site 10; Piakonui US2 in Figure 3-3) had a very similar fish community to the nearby site (Piakonui US1 in Figure 3-3) that was visited in 2012.

Fish length data provide information on fish recruitment and survival rates. The length data for the three most common species (shortfin eel, longfin eel and Cran's bully) were pooled from all sites and used as an indicator of fish survival and recruitment at a catchment scale (Figure 3-4). The number of small shortfin eels (<200 mm) indicates reasonably good recruitment of this species occurred in the Piako catchment in 2013. The abundance of shortfin eels in the 300-400 mm range indicates recruitment in previous years was also reasonable. Downstream migration of adult male shortfins typically occurs at between 350-500 mm in length (Todd 1980), which is reflected in a significant drop in abundance at this size class. Shortfins greater >500 mm are generally females, which migrate at a larger size. The very low abundance of shortfin eels in these larger size classes indicates that few females are reaching maturity. This could have implications for future recruitment.

The lower overall abundance of longfin eels means that the length-frequency distribution of this species is less well defined. However, it is clear that the smaller size classes (<300 mm) are significantly underrepresented in the population relative to shortfin eels (Figure 3-4). Longfin males are generally thought to undertake their downstream migration at a length of approximately 500-700 mm, with all larger fish being females (Todd 1980). As with the shortfin eel, the abundance of larger individuals (females) is relatively low. However, of more

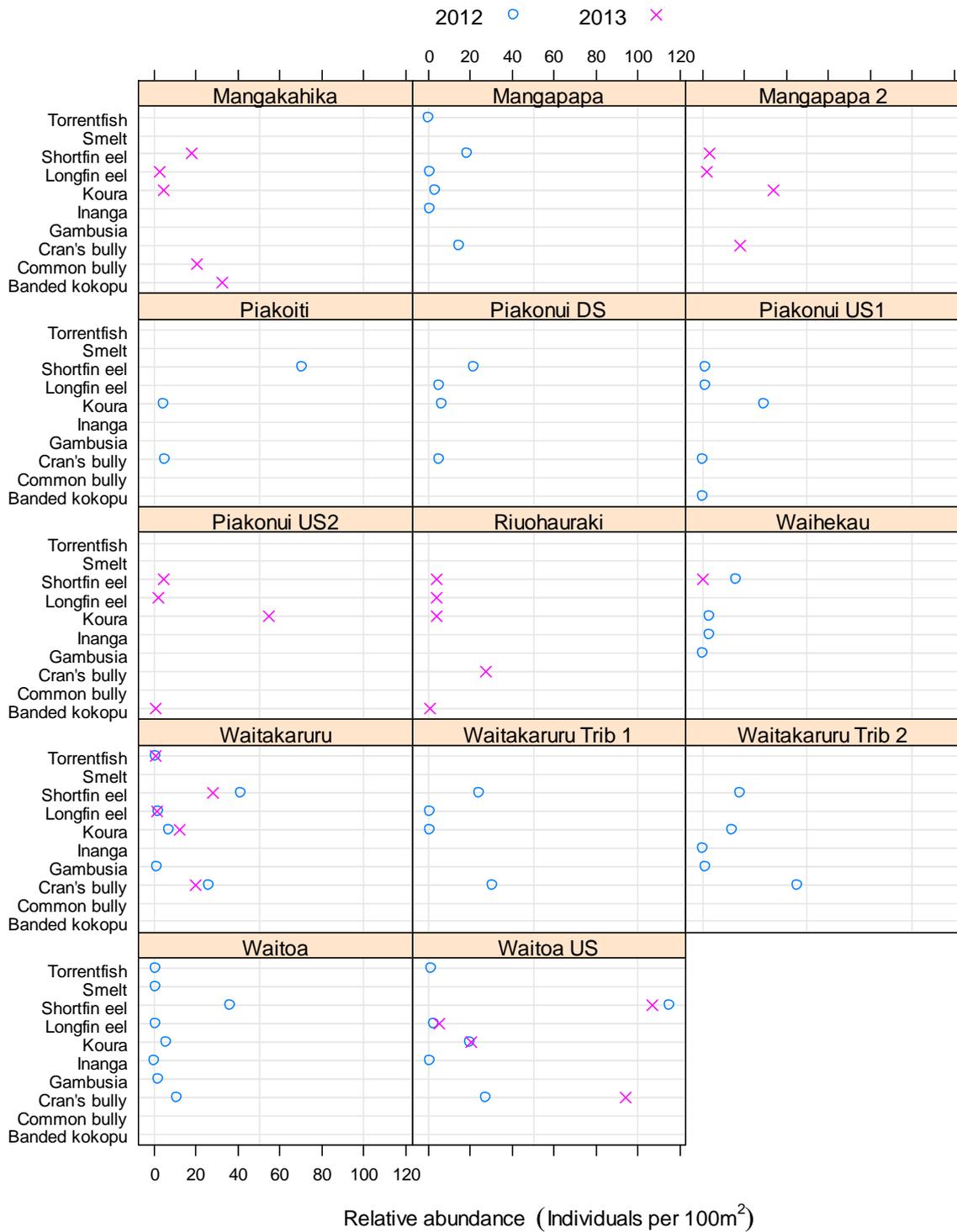
concern is that these larger individuals comprise a relatively large proportion of the overall longfin eel population in the Piako catchment. Given that this species is long-lived (female age at maturity >20 years), this indicates that there may have been poor recruitment of this species for a number of decades.

The Cran's bully length-frequency distribution indicates that in the tributaries where they occur there is good recruitment (as indicated by the high proportion of the population <40 mm) and relatively good survival rates, with a good proportion of the population also reaching the larger size classes (70-90 mm) (McDowall 2000).

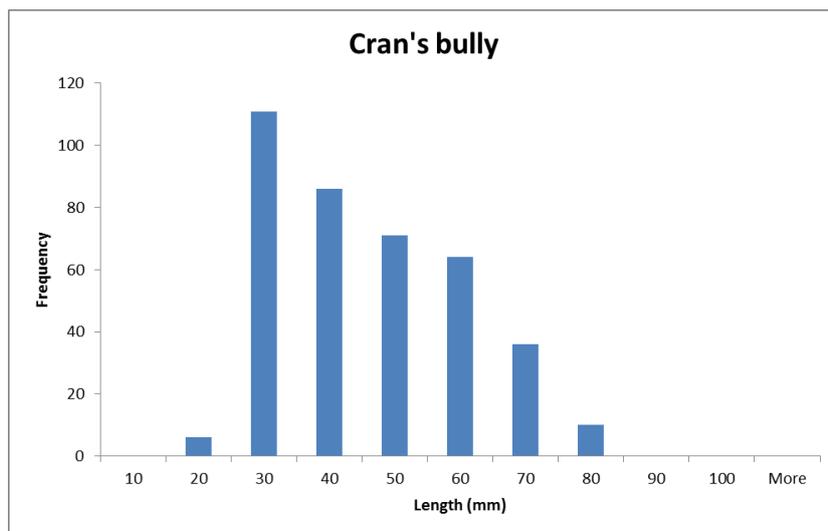
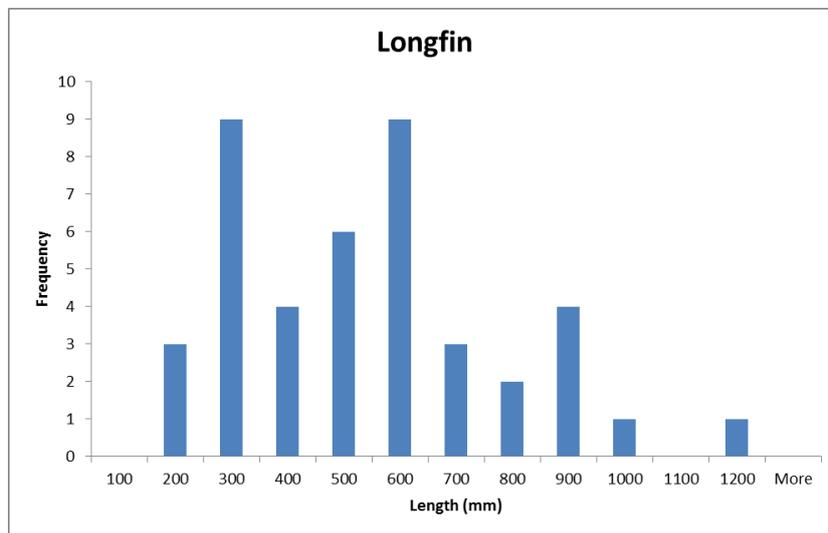
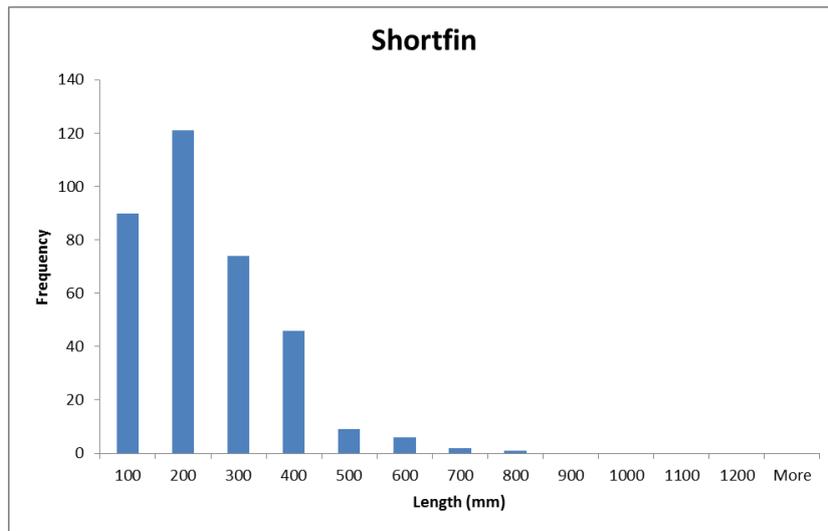
No trout were again recorded from any of the Piako monitoring sites and have still not been recorded in the catchment.

**Table 3-5: Results of 2013 electric fishing survey at the seven Piako catchment monitoring sites.** Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m<sup>2</sup>).

Site	Shortfin eel		Longfin eel		Cran's bully		Common bully		Torrentfish		Banded kokopu		Koura	
	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.
1. Mangakahika Stream	36	17.7	5	2.5	-	-	41	20.1	-	-	66	32.4	9	4.4
2. Riuohauraki Stream	9	4	9	4	62	27.2	-	-	-	-	1	0.4	9	4
5. Waitoa River U/S	199	107	10	5.4	175	94.1	-	-	-	-	-	-	38	20.4
6. Mangapapa Stream	16	3.4	8	1.7	86	18.2	-	-	-	-	-	-	160	33.9
8. Waiheka Stream	1	0.2	-	-	-	-	-	-	-	-	-	-	-	-
9. Waitakaruru Stream	82	27.8	3	1.1	56	19.7	-	-	1	0.4	-	-	34	11.9
10. Piakonui Stream	16	4.4	7	1.9	-	-	-	-	-	-	2	0.6	200	54.9



**Figure 3-3: Comparison between the relative abundance of fish captured in the 2012 and 2013 Piako surveys.**



**Figure 3-4: Summary of fish length for the three most abundant fish species captured in the 2013 Piako fish surveys.** Length data from all seven sites are pooled.

### 3.2.2 Macroinvertebrates

All sites except Site 8 were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m<sup>2</sup> sampled at each site. Sampling at Site 8 followed MFE protocol C2 for soft-bottomed streams. A full taxa list is included in Appendix C.

Total taxa and EPT richness were highest at Sites 1 and 2 and lowest at Site 8 (Table 3-6). Both Sites 1 and 2 are relatively small headwater streams, with native riparian cover present through much of the reach. Site 8 is a lowland agricultural stream that has been subject to channel modification and had extremely high macrophyte cover in 2013. Sites 1 and 6 have the highest %EPT and MCI scores (Table 3-6). %EPT is lower at 54.4% for Site 2, but the MCI score for this site is still in the 'Good' quality class. The reduced %EPT score at Site 2 seems to be a consequence of a relatively large number (38) of *Archichauliodes* (Dobsonfly larva) being present in the sample. The lowest %EPT (27.0) and MCI scores (66.7) were recorded at Site 8 (Waiheka Stream), placing it in the 'Poor' quality class. In most cases, the respective scores for each of the indices broadly match the habitat type, with more natural channel forms with intact riparian cover typically associated with higher scores. The main exception to this pattern was Site 10, which was a headwater stream with diverse habitat in native bush. The scores for all four indices at Site 10 were lower than might be expected for a stream of this type (Table 3-6). The abundance of fish was also low at this site (Table 3-5), although the abundance of koura (*Paranephrops planifrons*) was very high (55 individuals per 100 m<sup>2</sup>; Table 3-5). The low abundance of fish may partially be a consequence of distance inland and the presence of downstream migration barriers, but the reason for the low abundance of macroinvertebrates is unclear.

At those sites with results available from both the 2012 and 2013 surveys (Sites 8 & 9), total taxa richness was lower in 2013 at Site 8 and higher at Site 9, but EPT richness very similar at both sites. The %EPT score was slightly higher for both sites in 2013, but the MCI score for Site 9 was significantly lower at 83.5 (Fair) compared to 104.6 (Good) in 2012. MCI score at Site 8 was also lower in 2013, but remained in the same quality class (Poor).

**Table 3-6: Summary of macroinvertebrate results for the seven Piako monitoring sites in 2013.** The sample for Site 5 was not preserved correctly and therefore results are not available.

Site	Total taxa richness	EPT richness	%EPT	MCI
1. Mangakahika Stream	24	15	71.0	120.0
2. Riuohauraki Stream	21	13	54.4	111.4
5. Waitoa River	NA	NA	NA	NA
6. Mangapapa Stream	16	8	74.8	115.0
8. Waiheka Stream	9	3	27.0	66.7
9. Waitakaruru Stream	18	8	41.8	83.5
10. Piakonui Stream	10	4	31.3	106.0

### 3.2.3 Macrophytes & periphyton

The majority of sites surveyed in 2013 were hard-bottomed streams with a low abundance of macrophytes (Table 3-7; Appendix D). The main exception was Site 8 on the Waiheka Stream, where *Elodea canadensis* was highly abundant (MTC 96%) and blocked a significant proportion of the stream. This was a significant increase compared to 2012 (MTC 56%). The proliferation of macrophytes at this site was the main reason for the inability to effectively complete the fish survey. It is likely that the drought conditions, and hence low flows, in 2013 are a significant driver for the expansion of macrophytes at this site. In the 2012 survey, macrophytes were recorded at Site 5 in low abundance, but were absent in 2013. It is likely that this can be attributed to the presence of cattle in the stream in 2013.

**Table 3-7: Summary of macrophyte indices for the seven Piako monitoring sites in 2013.** MTC = Macrophyte Total Cover; MCC = Macrophyte Channel Cloginess; MNC = Macrophyte Native Cover.

Site	MTC	MCC	MNC
1. Mangakahika Stream	0	0	0
2. Riuohauraki Stream	0	0	0
5. Waitoa River	0	0	0
6. Mangapapa Stream	0.4	0.2	0
8. Waiheka Stream	96	52	0
9. Waitakaruru Stream	1.4	0.7	0
10. Piakonui Stream	0	0	0

Periphyton cover was present at all seven of the Piako monitoring sites in 2013 (Table 3-8; Appendix D). The highest cover was observed at Site 8, where the PEI was 90.0 and the community was dominated by green filamentous algae (PFI 100). No periphyton was recorded at this site in 2012. Lowest periphyton cover was recorded at Sites 1, 5 and 10 (PEI 12.4, 22.5 & 28.5 respectively). PSI was also highest at Site 8 (68.8), and associated with lower macroinvertebrate scores (Table 3-7). However, Site 6 had a PSI score of 49.6, but an MCI score that placed it in the 'Good' quality class.

**Table 3-8: Summary of periphyton indices for the seven Piako monitoring sites in 2013.** PEI = Periphyton Enrichment Index; PFI = Periphyton Filamentous Index; PMI = Periphyton Mat Index; PPI = Periphyton Proliferation Index; PSI = Periphyton Slimyness Index.

Site	PEI	PFI	PMI	PPI	PSI
1. Mangakahika Stream	12.4	0	0	0	14.8
2. Riuohauraki Stream	35.5	40.3	0	40.3	36.8
5. Waitoa River	22.5	0	0	0	28.8
6. Mangapapa Stream	38.9	0	27.8	27.8	49.6
8. Waiheka Stream	90.0	100.0	0	100.0	68.8
9. Waitakaruru Stream	31.4	0	2.9	2.9	40.0
10. Piakonui Stream	28.5	0	0	0	27.2

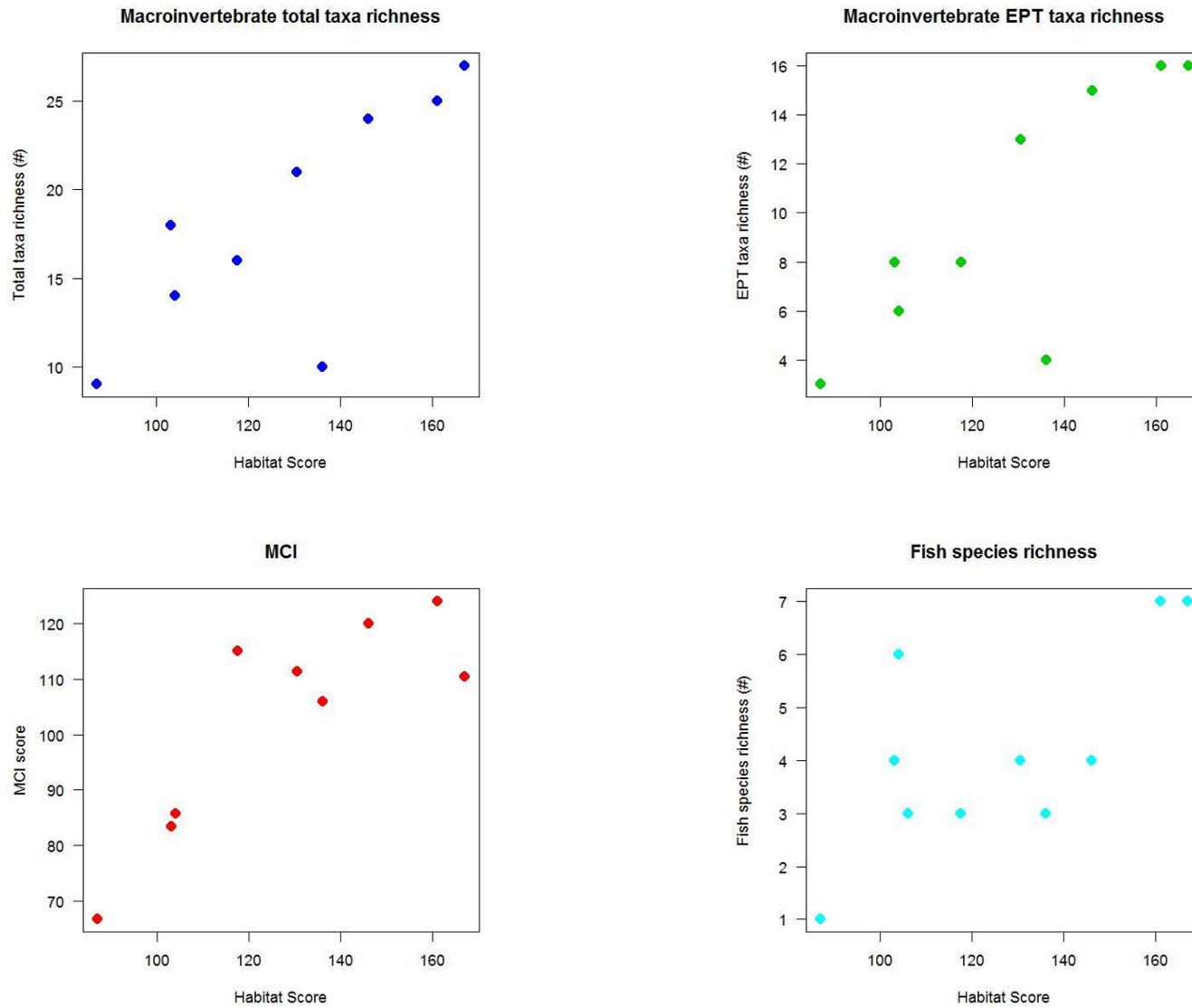
### 3.3 Habitat quality

The habitat assessment provides a composite index of both landscape scale and biotic characteristics of the stream, which can be used as an indicator of habitat quality. Full details of the habitat assessment are included in Appendix A and scores are summarised in Table 3-9. Broadly, the higher the score, the better the habitat is.

**Table 3-9: Habitat assessment scores in 2013.**

Site	Catchment	Habitat Score
1. Mangakahika Stream	Piako	146.0
2. Riuohauraki Stream	Piako	130.5
3. Paiakarahi Stream DS	Waihou	161.0
4. Paiakarahi Stream US	Waihou	137.0
5. Waitoa River	Piako	106.0
6. Mangapapa Stream	Piako	117.5
7. Karengorengo Stream	Waihou	104.0
8. Waihekau Stream	Piako	87.0
9. Waitakaruru Stream	Piako	103.0
10. Piakonui Stream	Piako	136.0

Correlations between habitat score and biotic indices were evaluated using the non-parametric Spearman's rank correlation ( $\rho$ ). Sample sizes were small, but the habitat score correlated most strongly with the macroinvertebrate metrics (Total taxa richness  $\rho=0.78$ ; EPT richness  $\rho=0.80$ ; MCI  $\rho=0.73$ ; Figure 3-5). A moderate correlation was also identified with fish species richness ( $\rho=0.59$ ; Figure 3-5). The lower strength of the correlation with fish species richness reflects the strong effect that distance inland and elevation can have on fish communities dominated by diadromous species. Broadly, the higher the habitat score, the higher the diversity and quality of macroinvertebrate communities and the higher the diversity of fish species. This matches expectations that fish and macroinvertebrate communities are generally degraded in streams with poorer instream and riparian habitat. This was also reflected in strong positive correlations between fish species richness and macroinvertebrate total taxa richness ( $\rho=0.80$ ) and EPT richness ( $\rho=0.78$ ), suggesting that where a site supports species rich communities of macroinvertebrates, it is also likely to support species rich communities of fish.



**Figure 3-5: Scatterplots of biotic indices against habitat score.**

## 4 Discussion

One of the fundamental objectives of setting water resource use limits is the protection of aquatic ecosystems. Setting robust limits requires an understanding of both the current status of ecological communities and changes in their status over time. The current status of ecological communities represents the combined effects of both natural environmental and biotic controls, e.g., distance inland, elevation, river type, species' life histories, and the consequences of human induced changes to the environment, e.g., land use change, reduced water quality and river channel engineering. Changes in status over time will also be driven by a combination of natural variability in environmental and biotic conditions (i.e., wet v. dry years; warm v. cold years; good v. bad recruitment; high v. low survival), and changes to the environment made by humans, e.g., water abstraction, pollutant discharges, land drainage and stream restoration.

Ecological monitoring is essential to understanding ecological status and trends. The combined results of the 2012 (Franklin & Bartels 2012) and 2013 ecological monitoring surveys provide a valuable assessment of the spatial patterns in aquatic communities across the middle and upper parts of the Piako catchment. The Piako catchment is significantly impacted by land use change and the effects of agricultural development and intensification. This is evident in the baseline monitoring results, with the low gradient, lowland streams that are subject to the greatest pressures typically supporting poorer quality and less diverse ecological communities. There is also evidence to suggest that fish communities in the Piakoiti/Piakonui sub-catchment are limited by the presence of a downstream migration barrier, as indicated by the continued absence of non-climbing fish species (e.g., inanga) in these sub-catchments. However, given the discovery of good numbers of juvenile banded kokopu in the Mangakahika Stream (downstream of Morrinsville), which indicates they are successfully recruiting to the Piako catchment, the low number of this climbing species recorded in the Piakoiti/Piakonui sites with suitable habitat stands out as requiring further investigation. Despite their presence at a number of sites in the 2012 survey, no inanga were recorded from the Piako survey sites in 2013. Whilst not of immediate concern, as their abundance was low at all sites where they were previously found, it is recommended that this be monitored in future surveys as their absence could be an indicator of instream conditions. The low abundance and poor recruitment and survival of longfin eels at all sites is of potential concern at a catchment scale.

In 2013, a sub-set of three sites in the Waihou catchment were also re-surveyed. Patterns in fish communities were broadly similar to previous surveys in 2009 and 2011 (Franklin & Booker 2009, Franklin et al. 2011). The most notable difference was the lower abundance of shortfin eel and smelt at the Karengorengo Stream site, but it is thought this is largely due to reduced sampling efficiency caused by excessive macrophyte growth. MCI scores were generally lower in 2013 relative to the previous surveys. It is possible this could be attributable to the low flows experienced in 2013, but longer term monitoring would be required to confirm such an effect.

To support the review and ongoing implementation of water allocation limits in the Waihou and Piako catchments, it is recommended that routine ecological monitoring continue in both catchments. It is proposed that monitoring five sites in each catchment annually would provide the best compromise between spatial coverage and characterising natural inter-annual variations in the biotic communities. Ten locations potentially suitable for an annual

ecological monitoring programme are proposed in Table 4-1. These sites are representative of a range of river types typical of each catchment (i.e., lowland, upland, more modified, less modified, different tributaries). Nine of the ten sites have been included in this or the previous surveys of the Waihou and Piako (Franklin & Bartels 2012, Franklin & Booker 2009, Franklin et al. 2011), and thus build on the existing dataset. These sites were selected based on their spatial coverage of the catchments, representativeness of different stream types, ease of access and suitability for the standard sampling methodologies. It is suggested that the tenth site be located in the Ohinemuri River sub-catchment. Consideration should be given to establishing a new site on a tributary downstream of the Ohinemuri Weir, which may be more suitable for long-term monitoring than the sites previously surveyed in this catchment (tributary of the Homunga Stream), which targeted an irrigation abstraction. It is recognised that WRC may have alternative preferences or sites they wish to include.

In addition to establishing annual monitoring sites, it may also be valuable to identify an additional group of sites that would be monitored every 3-5 years, to improve the spatial coverage of the monitoring. It may also be useful to collect additional data on characteristics such as flow, water temperature, dissolved oxygen and water quality at the annual monitoring sites to better understand the relative importance of different environmental variables in determining the observed variations in ecology (and their associations with flow).

**Table 4-1: Proposed annual ecological monitoring sites for the Waihou and Piako catchments.**

Catchment	Stream	Easting*	Northing*
Waihou	Karengorengo Stream	2758628	6384754
Waihou	Paiakarahi Stream	2751431	6429122
Waihou	Waiteariki Stream	2762794	6379697
Waihou	Wairere Stream	2761891	6381355
Waihou	Tributary of the Ohinemuri River	TBC	TBC
Piako	Mangapapa Stream	2747006	6371508
Piako	Waitakaruru Stream	2727985	6377350
Piako	Waitoa Stream	2742190	6365404
Piako	Piakonui Stream	2741486	6371826
Piako	Mangakahika Stream	2728975	6400407

\*Easting and northing given for downstream limit of survey reach (NZMG coordinates).

## 5 Conclusion

Reliable information on the status and dynamics of instream ecosystems is a key component of achieving a sustainable water allocation framework that meets freshwater objectives. Knowledge of natural dynamics and variability in New Zealand's freshwater ecological communities is relatively limited. However, to monitor human impacts on aquatic biota it is essential to understand and be able to distinguish natural drivers of change. Establishing a long-term routine ecological monitoring network allows the identification of instream values and characterisation of trends and differences in community population dynamics over time and between sites. This provides the knowledge that can be used to support development of robust and transparent management policies.

The monitoring that has been carried out so far in the Waihou and Piako catchments has established a baseline against which to measure future changes. Evidence is already emerging of differences in the structure and diversity of ecological communities between more and less heavily modified sites. Potential implications for water allocation may include protection of high diversity sites and/or rehabilitation of degraded sites e.g., riparian planting, to compensate for the potential impacts of increased allocation.

The process of developing water allocation rules must be robust and transparent. The resulting water allocation framework must be sustainable and support adaptive management of water resources. Reliable information on the status and dynamics of instream values is a key component in achieving this.

## 6 References

- Collier, K., Kelly, J. (2005) Regional guidelines for ecological assessments of freshwater environments: Macroinvertebrate sampling in wadeable streams. *Environment Waikato Technical Report*, No. TR2005/02: 28.
- Collier, K., Kelly, J., Champion, P.D. (2006) Regional guidelines for ecological assessments of freshwater environments: Aquatic plant cover in wadeable streams. *Environment Waikato Technical Report*, No. TR2006/47: 33.
- David, B., Hamer, M. (2010) Regional guidelines for ecological assessments of freshwater environments: Standardised fish monitoring for wadeable streams. *Environment Waikato Technical Report*, No. 2010/09: 31.
- Franklin, P.A., Bartels, B. (2012) Piako catchment ecological monitoring 2012. *NIWA Client Report*, No. HAM2012-070: 94.
- Franklin, P.A., Booker, D.J. (2009) Flow regime requirements for instream ecology in the Waihou River catchment. *NIWA Client Report*, No. HAM2009-089: 176.
- Franklin, P.A., Croker, G., Julian, K., Smith, J., Bartels, B. (2011) Waihou catchment ecological monitoring 2011. *NIWA Client Report*, No. HAM2011-036: 91.
- McDowall, R.M. (2000) *The Reed field guide to New Zealand freshwater fishes*. Reed, Auckland: 224.
- MfE (2011) *National Policy Statement for Freshwater Management 2011*: 12.
- Stark, J.D., Maxted, J.R. (2007) A user guide for the Macroinvertebrate Community Index. *Cawthron Report*, No. 1166: 58.
- Todd, P.R. (1980) Size and age of migrating New Zealand freshwater eels (*Anguilla* spp.). *New Zealand Journal of Marine and Freshwater Research*, 14(3): 283–293. <<http://dx.doi.org/10.1080/00288330.1980.9515871>>
- Waikato Regional Council (2012) *Proposed Waikato Regional Plan: Variation No. 6 - Water Allocation*: 82.



Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Mangakahika Stream										Site number: 1										
Sample number:					Assessor: Paul Franklin					Date:18/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 16																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>• Little/no islands or point bars present</li> <li>• &lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>• New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>• 20-50% of bottom affected</li> <li>• Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>• Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>• 50-80% of bottom affected</li> <li>• Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>• Heavy deposits of fine material</li> <li>• Increased bar development</li> <li>• &gt;80% of bottom changing frequently</li> <li>• Pools almost absent due to sediment deposition</li> </ul>				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>• 4 velocity/depth regimes present</li> <li>• Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>• 3 Of 4 velocity/depth regimes present</li> <li>• If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>• 2 of 4 velocity/depth regimes present</li> <li>• If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>• Dominated by 1 velocity/depth regime</li> <li>• Usually deep/slow</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>• &gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>• Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>• Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>• 30-50% substrate favourable for invertebrate colonisation</li> <li>• Snags/ submerged logs/undercut banks/cobbles</li> <li>• Fish cover common</li> <li>• Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>• 10-30% substrate favourable for invertebrate colonisation</li> <li>• Fish cover patchy</li> <li>• 60-90% substrate easily moved by foot</li> <li>• Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>• &lt;10% substrate favourable for invertebrate colonisation</li> <li>• Fish cover rare or absent</li> <li>• Substrate unstable or lacking</li> <li>• Stable habitats lacking or limited to macrophytes</li> </ul>				
Score:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>• Periphyton not evident on hand held stones</li> <li>• Stable substrate</li> <li>• Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton not visible on stones</li> <li>• Stable substrate</li> <li>• Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton visible</li> <li>• &lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton obvious &amp; prolific</li> <li>• &gt;20% cover of available substrates</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 146																				

<b>Field Assessment Cover Form</b>					
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>					
Stream name: Riuohauraki Stream			Assessor: Paul Franklin		
Site number: 2		Sample number:		Date: 18/2/13	Time: 15:00
GPS coordinates		Downstream:		E 2729470	N 6402548
		Upstream:		E 2729382	N 6402591
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open                      Partly shaded <b>Very shaded</b>					
Fencing:		Dominant riparian vegetation:		Stream width (active channel): 3m	
None/ineffective		Crops                      Retired vegetation		Stream width (water): 1.5m	
One side/partial		Pasture <b>Native shrub</b>		Stream depth: 0.2m	
<b>Complete</b>		Exotic trees                      Native trees		Surface velocity: 0.2m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		20.7                      °C		Conductivity:                      241.9                      µS cm <sup>-1</sup>	
Dissolved oxygen:		86.5                      %		mg l <sup>-1</sup>	
Turbidity:		Clear	Slightly turbid	Highly turbid	Stained                      Other
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage		
<b>Moderately packed with some overlapping</b>			Bedrock                      -		
Mostly a loose assortment with little overlap			Boulder                      >256mm                      40		
No packing/loose assortment easily moved			Cobble                      >64-256mm                      35		
<b>Embeddedness:</b>			Gravel                      >2-64mm                      20		
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm                      5		
<5% <b>5-25%</b> 26-50%                      51-75%                      >75%			Silt                      0.004-0.06mm		
			Clay                      <0.004mm		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<5%                      5-25%                      26-50%                      51-75%                      >75%			Stones:                      100%		
Coarse detritus (small wood, sticks, leaves et al. >1mm)			Wood:                      %                      Riffles:                      100 %		
<5% <b>5-25%</b> 26-50%                      51-75%                      >75%			Macrophyte:                      %                      Runs:                      %		
Fine (<1mm) organic deposits			Edges:                      %		
<5%                      5-25%                      26-50%                      51-75%                      >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Shrimps:		
<5%                      5-25%                      26-50%                      51-75%                      >75%			Crabs:		
Macrophytes:			Mussels:		
<5%                      5-25%                      26-50%                      51-75%                      >75%			Other:		
Mosses/liverworts:			Mussel type:		
<5%                      5-25%                      26-50%                      51-75%                      >75%			<i>Hyridella</i>		
			<i>Cucumerunio</i>		
Comments:					

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Riuohauraki Stream										Site number: 2										
Sample number:					Assessor: Paul Franklin					Date:18/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10.5																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 16																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held stones</li> <li>Stable substrate</li> <li>Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 130.5																				

Field Assessment Cover Form					
Wadeable Hard-Bottomed and Soft-Bottomed Streams					
Stream name: Paiakarahi Stream D/S			Assessor: Paul Franklin		
Site number: 3		Sample number:		Date: 19/02/13	Time: 13:10
GPS coordinates		Downstream:		E2751347	N6429422
		Upstream:		E2751418	N6429342
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open                      Partly shaded <b>Very shaded</b>					
Fencing:		Dominant riparian vegetation:		Stream width (active channel):6m	
<b>None/ineffective</b>		Crops                      Retired vegetation		Stream width (water): 2.5m	
One side/partial		Pasture                      Native shrub		Stream depth: 0.3m	
Complete		Exotic trees <b>Native trees</b>		Surface velocity: 0.3m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		18.6                      °C		Conductivity:                      102                      µS cm <sup>-1</sup>	
Dissolved oxygen:		98                      %		9.2                      mg l <sup>-1</sup>	
Turbidity:		<b>Clear</b>		Slightly turbid	Highly turbid
				Stained	Other
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage		
Moderately packed with some overlapping			Bedrock                      -		
<b>Mostly a loose assortment with little overlap</b>			Boulder                      >256mm                      30		
No packing/loose assortment easily moved			Cobble                      >64-256mm                      60		
<b>Embeddedness:</b>			Gravel                      >2-64mm                      10		
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm		
<b>&lt;5%</b>                        5-25%                                             26-50%                                             51-75%                                             >75%			Silt                      0.004-0.06mm		
			Clay                      <0.004mm		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<b>&lt;5%</b>   <b>5-25%</b>                        26-50%                                             51-75%                                             >75%			Stones:                      100%		
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:                      %                      Riffles:                      100 %		
<b>&lt;5%</b>   <b>5-25%</b>                        26-50%                                             51-75%                                             >75%			Macrophyte:                      %                      Runs:                      %		
Fine (<1mm) organic deposits			Edges:                      %		
<b>&lt;5%</b>                        5-25%                                             26-50%                                             51-75%                                             >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Shrimps:		
<b>&lt;5%</b>                        5-25%                                             26-50%                                             51-75%                                             >75%			Crabs:		
Macrophytes:			Mussels:		
<b>&lt;5%</b>                        5-25%                                             26-50%                                             51-75%                                             >75%			Other:		
Mosses/liverworts:			Mussel type:		
<b>&lt;5%</b>                        5-25%                                             26-50%                                             51-75%                                             >75%			<i>Hyridella</i>		
			<i>Cucumerunio</i>		
Comments:					

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Paiakarahi Stream D/S										Site number: 3										
Sample number:					Assessor: Paul Franklin					Date: 19/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 19																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach Channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on substrates but obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:161																				

<b>Field Assessment Cover Form</b>					
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>					
Stream name: Paiakarahi Stream U/S			Assessor: Paul Franklin		
Site number: 4		Sample number:		Date: 19/02/13	Time: 15:45
GPS coordinates		Downstream:		E2751431	N6429122
		Upstream:		E2751550	N6429031
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open <b>Partly shaded</b> Very shaded					
Fencing:		Dominant riparian vegetation:		Stream width (active channel): 12m	
<b>None/ineffective</b>		Crops                      Retired vegetation		Stream width (water): 6m	
One side/partial		Pasture                      Native shrub		Stream depth: 0.3m	
Complete		Exotic trees <b>Native trees</b>		Surface velocity: 0.3m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		18.6                      °C		Conductivity: 102                      μS cm <sup>-1</sup>	
Dissolved oxygen:		98                      %		9.2                      mg l <sup>-1</sup>	
Turbidity:		Clear	Slightly turbid	Highly turbid	Stained                      Other
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage		
Moderately packed with some overlapping			Bedrock                      -                      -		
<b>Mostly a loose assortment with little overlap</b>			Boulder                      >256mm                      85		
No packing/loose assortment easily moved			Cobble                      >64-256mm                      10		
<b>Embeddedness:</b>			Gravel                      >2-64mm                      5		
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Silt                      0.004-0.06mm		
			Clay                      <0.004mm		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Stones:                      100%		
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:                      %                      Riffles:                      100%		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Macrophyte:                      %                      Runs:                      %		
Fine (<1mm) organic deposits			Edges:                      %		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Crabs:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Other:		
Macrophytes:			Mussel type:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			<i>Hyridella</i>		
Mosses/liverworts:			<i>Cucumerunio</i>		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%					
Comments:					

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Paiakarahi Stream U/S										Site number: 4										
Sample number:					Assessor: Paul Franklin					Date: 19/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 20																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held stones</li> <li>Stable substrate</li> <li>Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 167																				

<b>Field Assessment Cover Form</b>								
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>								
Stream name: Waitoa Tributary			Assessor: Paul Franklin					
Site number: 5		Sample number:		Date: 20/02/13	Time: 12:40			
GPS coordinates		Downstream:		E 2742184	N 6365455			
		Upstream:		E 2742094	N 6365394			
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>					
<b>Canopy cover:</b>			Estimated or measured reach average:					
<table border="0"> <tr> <td><b>Open</b></td> <td>Partly shaded</td> <td>Very shaded</td> </tr> </table>			<b>Open</b>	Partly shaded	Very shaded			
<b>Open</b>	Partly shaded	Very shaded						
Fencing:		Dominant riparian vegetation:		Stream width (active channel): 5m				
<b>None/ineffective</b>		Crops		Retired vegetation				
One side/partial		<b>Pasture</b>		Native shrub				
Complete		Exotic trees		Native trees				
			Stream width (water): 2m					
			Stream depth: 0.25m					
			Surface velocity: 0.7m s <sup>-1</sup>					
<b>Water quality</b>								
Temperature:		18 °C		Conductivity: 126 µS cm <sup>-1</sup>				
Dissolved oxygen:		89 %		8.4 mg l <sup>-1</sup>				
Turbidity:		Clear	Slightly turbid	Highly turbid	Stained			
					Other			
<b>Stream-bottom substrata</b>								
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>					
Assorted sizes tightly packed &/or overlapping			Substratum   Dimension   Percentage					
<b>Moderately packed with some overlapping</b>			Bedrock   -					
Mostly a loose assortment with little overlap			Boulder   >256mm   70					
No packing/loose assortment easily moved			Cobble   >64-256mm   15					
<b>Embeddedness:</b>			Gravel   >2-64mm   5					
(% gravel-boulder particles covered by fine sediment)			Sand   >0.06-2mm   5					
<5%   <b>5-25%</b>   26-50%   51-75%   >75%			Silt   0.004-0.06mm   5					
			Clay   <0.004mm					
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>					
Large wood (>10cm diameter)			(% of effort)					
<5%   5-25%   26-50%   51-75%   >75%			Stones: 100%					
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood: %					
<5%   5-25%   26-50%   51-75%   >75%			Riffles: 100%					
Fine (<1mm) organic deposits			Macrophyte: %					
<5%   5-25%   26-50%   51-75%   >75%			Edges: %					
<b>Instream plant cover</b> (% streambed area)			Number of invertebrates returned:					
Filamentous algae & mats:			Koura:					
<5%   5-25%   26-50%   51-75%   >75%			Shrimps:					
Macrophytes:			Crabs:					
<5%   5-25%   26-50%   51-75%   >75%			Mussels:					
Mosses/liverworts:			Other:					
<5%   5-25%   26-50%   51-75%   >75%			Mussel type:					
			<i>Hyridella</i>					
			<i>Cucumerunio</i>					
Comments: John Silcock 55 Peake Rd RD3 Hamilton 078234225 021957660								

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Waitoa Tributary										Site number: 5										
Sample number:					Assessor: Paul Franklin					Date: 20/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 3.5																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:2	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 1.5																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held stones</li> <li>Stable substrate</li> <li>Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:106																				

<b>Field Assessment Cover Form</b>					
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>					
Stream name: Mangapapa Stream			Assessor: Paul Franklin		
Site number: 6		Sample number:		Date: 20/02/13	Time: 14:20
GPS coordinates		Downstream:		E 2744443	N 6368529
		Upstream:		E 2744319	N 6368540
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open <b>Partly shaded</b> Very shaded					
Fencing:		Dominant riparian vegetation:		Stream width (active channel):3m	
None/ineffective		Crops                      Retired vegetation		Stream width (water): 2.5m	
<b>One side/partial</b>		Pasture                      Native shrub		Stream depth: 0.3m	
Complete		<b>Exotic trees</b> Native trees		Surface velocity: 0.2m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		19.1                      °C		Conductivity:                      102                      μS cm <sup>-1</sup>	
Dissolved oxygen:		89                      %		8.2                      mg l <sup>-1</sup>	
Turbidity:		<b>Clear</b>		Slightly turbid	Highly turbid
				Stained	Other
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage		
<b>Moderately packed with some overlapping</b>			Bedrock                      -		
Mostly a loose assortment with little overlap			Boulder                      >256mm                      80		
No packing/loose assortment easily moved			Cobble                      >64-256mm                      20		
<b>Embeddedness:</b>			Gravel                      >2-64mm		
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm		
<5%                                             5-25%                        <b>26-50%</b>                        51-75%                                             >75%			Silt                      0.004-0.06mm		
			Clay                      <0.004mm		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Stones:                      100%		
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:                      %                      Riffles:                      100%		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Macrophyte:                      %                      Runs:                      %		
Fine (<1mm) organic deposits			Edges:                      %		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Shrimps:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Crabs:		
Macrophytes:			Mussels:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Other:		
Mosses/liverworts:			Mussel type:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			<i>Hyridella</i>		
			<i>Cucumerunio</i>		
Comments:					

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Mangapapa Stream										Site number: 6										
Sample number:					Assessor: Paul Franklin					Date: 20/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 11.5																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 16																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held stones</li> <li>Stable substrate</li> <li>Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 117.5																				

<b>Field Assessment Cover Form</b>						
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>						
Stream name: Karengorengo Stream			Assessor: Josh Smith			
Site number: 7		Sample number:		Date: 21/02/13	Time: 12:05	
GPS coordinates		Downstream:		E 2758631	N 6384786	
		Upstream:		E 2758661	N 6384650	
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>			
<b>Canopy cover:</b>			Estimated or measured reach average:			
Open                      Partly shaded                      Very shaded						
Fencing:		Dominant riparian vegetation:		Stream width (active channel):4m		
<b>None/ineffective</b>		Crops <b>Retired vegetation</b>		Stream width (water): 2.5m		
One side/partial		Pasture                      Native shrub		Stream depth: 0.4m		
Complete		Exotic trees                      Native trees		Surface velocity: 0.4m s <sup>-1</sup>		
<b>Water quality</b>						
Temperature:		15.0                      °C		Conductivity:                      188.2                      µS cm <sup>-1</sup>		
Dissolved oxygen:		74.3                      %		7.48                      mg l <sup>-1</sup>		
Turbidity:		Clear	Slightly turbid	Highly turbid	Stained	Other
<b>Stream-bottom substrata</b>						
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>			
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage			
Moderately packed with some overlapping			Bedrock                      -			
Mostly a loose assortment with little overlap			Boulder                      >256mm			
<b>No packing/loose assortment easily moved</b>			Cobble                      >64-256mm			
<b>Embeddedness:</b>			Gravel                      >2-64mm                      5			
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm                      90			
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Silt                      0.004-0.06mm                      5			
			Clay                      <0.004mm			
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>			
Large wood (>10cm diameter)			(% of effort)			
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Stones:                      %			
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:                      %                      Riffles:                      %			
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Macrophyte:                      %                      Runs:                      100%			
Fine (<1mm) organic deposits			Edges:                      %			
<5%                        <b>5-25%</b>                        26-50%                                             51-75%                                             >75%			Number of invertebrates returned:			
<b>Instream plant cover</b> (% streambed area)			Koura: common                                             Shrimps:common			
Filamentous algae & mats:			Crabs:                                             Mussels:			
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Other:                                             Mussel type:			
Macrophytes:			<i>Hyridella</i>   <i>Cucumerunio</i>			
<5%                        <b>5-25%</b>                        26-50%                                             51-75%                                             >75%						
Mosses/liverworts:						
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%						
Comments: Heavy macrophyte cover making fishing difficult						

Wadeable Soft-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Karengorengo Stream										Site number: 7										
Sample number:					Assessor: Josh Smith					Date: 21/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 7																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
4. Channel sinuosity	<ul style="list-style-type: none"> <li>Bends increase stream length 3-4 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Bends increase stream length 2-3 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Bends increase stream length 1-2 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Channel straight</li> </ul>				
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	<ul style="list-style-type: none"> <li>Pools evenly mixed</li> <li>Large/shallow, large/deep, small/shallow, small/deep</li> </ul>					<ul style="list-style-type: none"> <li>Majority of pools large/deep</li> <li>Very few shallow pools</li> </ul>					<ul style="list-style-type: none"> <li>Prevalence of shallow pools</li> </ul>					<ul style="list-style-type: none"> <li>Majority of pools small/shallow</li> </ul>				
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held stones</li> <li>Stable substrate</li> <li>Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 104																				



<b>Wadeable Soft-Bottomed Streams</b>																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Waiheka Stream										Site number: 8										
Sample number:					Assessor: Josh Smith					Date: 21/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 8																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14																				
4. Channel sinuosity	<ul style="list-style-type: none"> <li>Bends increase stream length 3-4 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Bends increase stream length 2-3 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Bends increase stream length 1-2 times longer than if it was straight</li> </ul>					<ul style="list-style-type: none"> <li>Channel straight</li> </ul>				
Score: 3	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter	Category Optimal					Habitat parameter								
6. Sediment deposition	<ul style="list-style-type: none"> <li>• Little/no islands or point bars present</li> <li>• &lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>• New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>• 20-50% of bottom affected</li> <li>• Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>• Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>• 50-80% of bottom affected</li> <li>• Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>• Heavy deposits of fine material</li> <li>• Increased bar development</li> <li>• &gt;80% of bottom changing frequently</li> <li>• Pools almost absent due to sediment deposition</li> </ul>				
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	<ul style="list-style-type: none"> <li>• Pools evenly mixed</li> <li>• Large/shallow, large/deep, small/shallow, small/deep</li> </ul>					<ul style="list-style-type: none"> <li>• Majority of pools large/deep</li> <li>• Very few shallow pools</li> </ul>					<ul style="list-style-type: none"> <li>• Prevalence of shallow pools</li> </ul>					<ul style="list-style-type: none"> <li>• Majority of pools small/shallow</li> </ul>				
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>• &gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>• Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>• Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>• 30-50% substrate favourable for invertebrate colonisation</li> <li>• Snags/ submerged logs/undercut banks/cobbles</li> <li>• Fish cover common</li> <li>• Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>• 10-30% substrate favourable for invertebrate colonisation</li> <li>• Fish cover patchy</li> <li>• 60-90% substrate easily moved by foot</li> <li>• Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>• &lt;10% substrate favourable for invertebrate colonisation</li> <li>• Fish cover rare or absent</li> <li>• Substrate unstable or lacking</li> <li>• Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>• Periphyton not evident on hand held stones</li> <li>• Stable substrate</li> <li>• Surfaces rough to touch</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton not visible on stones</li> <li>• Stable substrate</li> <li>• Periphyton obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton visible</li> <li>• &lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>• Periphyton obvious &amp; prolific</li> <li>• &gt;20% cover of available substrates</li> </ul>				
Score: 2	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 87																				

<b>Field Assessment Cover Form</b>					
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>					
Stream name: Waitakaruru Stream			Assessor: Paul Franklin		
Site number: 9		Sample number:		Date: 22/02/13	Time: 9:25
GPS coordinates		Downstream:		E 2727985	N 6377350
		Upstream:		E 2728142	N 6377272
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open <b>Partly shaded</b> Very shaded					
Fencing:		Dominant riparian vegetation:		Stream width (active channel):3m	
None/ineffective		Crops <b>Retired vegetation</b>		Stream width (water): 2.6m	
<b>One side/partial</b>		Pasture                      Native shrub		Stream depth: 0.2m	
Complete		Exotic trees                      Native trees		Surface velocity: 0.3m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		18.6                      °C		Conductivity:                      135                      μS cm <sup>-1</sup>	
Dissolved oxygen:		95                      %		8.9                      mg l <sup>-1</sup>	
Turbidity:		<b>Clear</b>		Slightly turbid	Highly turbid
				Stained	Other
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum                      Dimension                      Percentage		
<b>Moderately packed with some overlapping</b>			Bedrock                      -		
Mostly a loose assortment with little overlap			Boulder                      >256mm		
No packing/loose assortment easily moved			Cobble                      >64-256mm                      25		
<b>Embeddedness:</b>			Gravel                      >2-64mm                      50		
(% gravel-boulder particles covered by fine sediment)			Sand                      >0.06-2mm                      10		
<5%                                             5-25%                        <b>26-50%</b>                        51-75%                                             >75%			Silt                      0.004-0.06mm                      15		
			Clay                      <0.004mm		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Stones:                      100%		
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:                      %                      Riffles:                      100%		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Macrophyte:                      %                      Runs:                      %		
Fine (<1mm) organic deposits			Edges:                      %		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Shrimps:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Crabs:		
Macrophytes:			Mussels:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			Other:		
Mosses/liverworts:			Mussel type:		
<5%                                             5-25%                                             26-50%                                             51-75%                                             >75%			<i>Hyridella</i>		
			<i>Cucumerunio</i>		
Comments:					

Wadeable Hard-Bottomed Streams																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Waitakaruru Stream										Site number: 9										
Sample number:					Assessor: Paul Franklin					Date: 22/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 15																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach Channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score:13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on substrates but obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 103																				

<b>Field Assessment Cover Form</b>					
<b>Wadeable Hard-Bottomed and Soft-Bottomed Streams</b>					
Stream name: Piakonui Stream			Assessor: Paul Franklin		
Site number: 10		Sample number:		Date: 22/02/13	Time: 12:35
GPS coordinates		Downstream:		E 2741446	N 6377350
		Upstream:		E 2741436	N 6371564
<b>Channel &amp; riparian features</b>			<b>Instream hydraulic conditions</b>		
<b>Canopy cover:</b>			Estimated or measured reach average:		
Open                      Partly shaded <b>Very shaded</b>					
Fencing:		Dominant riparian vegetation:		Stream width (active channel): 6.5m	
None/ineffective		Crops		Retired vegetation	
One side/partial		Pasture		Native shrub	
<b>Complete</b>		Exotic trees		<b>Native trees</b>	
				Stream width (water): 3m	
				Stream depth: 0.35m	
				Surface velocity: 0.25m s <sup>-1</sup>	
<b>Water quality</b>					
Temperature:		15.1		°C	
Conductivity:		91.5		µS cm <sup>-1</sup>	
Dissolved oxygen:		99		%	
		9.8		mg l <sup>-1</sup>	
Turbidity:		<b>Clear</b>		Slightly turbid    Highly turbid    Stained    Other	
<b>Stream-bottom substrata</b>					
<b>Compaction (inorganic substrata):</b>			<b>% surficial inorganic substratum size composition:</b>		
Assorted sizes tightly packed &/or overlapping			Substratum    Dimension    Percentage		
<b>Moderately packed with some overlapping</b>			Bedrock    -    -		
Mostly a loose assortment with little overlap			Boulder    >256mm    90		
No packing/loose assortment easily moved			Cobble    >64-256mm    5		
<b>Embeddedness:</b>			Gravel    >2-64mm    -		
(% gravel-boulder particles covered by fine sediment)			Sand    >0.06-2mm    -		
<5%         5-25%         26-50%      <b>51-75%</b>      >75%			Silt    0.004-0.06mm    5		
			Clay    <0.004mm    -		
<b>Organic material (% cover)</b>			<b>Habitat types sampled</b>		
Large wood (>10cm diameter)			(% of effort)		
<5%      <b>5-25%</b>      26-50%         51-75%         >75%			Stones:    100%		
Coarse detritus (small wood, sticks, leaves etc., >1mm)			Wood:    %    Riffles:    100%		
<5%      <b>5-25%</b>      26-50%         51-75%         >75%			Macrophyte:    %    Runs:    %		
Fine (<1mm) organic deposits			Edges:    %		
<5%         5-25%         26-50%         51-75%         >75%			Number of invertebrates returned:		
<b>Instream plant cover</b> (% streambed area)			Koura:		
Filamentous algae & mats:			Shrimps:		
<5%         5-25%         26-50%         51-75%         >75%			Crabs:		
			Mussels:		
Macrophytes:			Other:		
<5%         5-25%         26-50%         51-75%         >75%			Mussel type:		
			<i>Hyridella</i>		
Mosses/liverworts:			<i>Cucumerunio</i>		
<5%      <b>5-25%</b>      26-50%         51-75%         >75%					
Comments:					

<b>Wadeable Hard-Bottomed Streams</b>																				
Qualitative Habitat Assessment Field Data Sheet																				
Stream name: Piakonui Stream										Site number: 10										
Sample number:					Assessor: Paul Franklin					Date: 22/02/13										
Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	<ul style="list-style-type: none"> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					<ul style="list-style-type: none"> <li>Bankside vegetation buffer is &lt;10m</li> <li>Mostly continuous</li> </ul>					<ul style="list-style-type: none"> <li>Pathways present and/or stock</li> <li>Mostly healed over</li> </ul>					<ul style="list-style-type: none"> <li>Breaks frequent</li> <li>Human activity obvious</li> </ul>				
Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18																				
2. Vegetative protection	<ul style="list-style-type: none"> <li>Bank surfaces &amp; immediate riparian zones covered by native vegetation</li> <li>Trees, under-storey shrubs or non-woody plants present</li> <li>Vegetative disruption minimal</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered mainly by native vegetation</li> <li>Disruption evident</li> <li>Banks may be covered by exotic forestry</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow &amp; introduced species</li> <li>Vegetation disruption obvious</li> <li>Bare soil/closely cropped vegetation common</li> </ul>					<ul style="list-style-type: none"> <li>Bank surfaces covered by grasses &amp; shrubs</li> <li>Disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Significant stock damage to bank</li> </ul>				
Left bank:20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 19																				
3. Bank stability	<ul style="list-style-type: none"> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul style="list-style-type: none"> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul style="list-style-type: none"> <li>Moderately unstable</li> <li>30-60% of bank in reach has areas of erosion</li> <li>High erosion potential during floods</li> </ul>					<ul style="list-style-type: none"> <li>Unstable</li> <li>Many eroded areas</li> <li>60-100% of bank has erosional scars</li> </ul>				
Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 16																				
4. Frequency of riffles	<ul style="list-style-type: none"> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					<ul style="list-style-type: none"> <li>Occurrence of riffles infrequent</li> <li>Distance between riffles divided by stream width=7-15</li> </ul>					<ul style="list-style-type: none"> <li>Occasional riffle or run</li> <li>Bottom contours provide some habitat</li> <li>Distance between riffles divided by stream width=15-25</li> </ul>					<ul style="list-style-type: none"> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</li> </ul>				
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	<ul style="list-style-type: none"> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					<ul style="list-style-type: none"> <li>Some changes to channel/dredging</li> <li>Evidence of past channel/dredging</li> <li>Recent channel/dredging not present</li> </ul>					<ul style="list-style-type: none"> <li>Channel changes/dredging extensive</li> <li>Embankments/shoring structures present on both banks</li> <li>40-80% of reach Channelized &amp; disrupted</li> </ul>					<ul style="list-style-type: none"> <li>Banks shored with gabion/cement</li> <li>&gt;80% of stream reach channelized or disrupted</li> <li>Instream habitat altered/absent</li> </ul>				
Score: 20	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	<ul style="list-style-type: none"> <li>Little/no islands or point bars present</li> <li>&lt;20% of bottom affected by sediment deposition</li> </ul>					<ul style="list-style-type: none"> <li>New increase in bar formation, mostly from gravel, sand or fine sediment</li> <li>20-50% of bottom affected</li> <li>Slight deposition in pools</li> </ul>					<ul style="list-style-type: none"> <li>Some deposition of new gravel, sand or fine sediment on old &amp; new bars</li> <li>50-80% of bottom affected</li> <li>Sediment deposits at obstructions, constrictions &amp; bends</li> </ul>					<ul style="list-style-type: none"> <li>Heavy deposits of fine material</li> <li>Increased bar development</li> <li>&gt;80% of bottom changing frequently</li> <li>Pools almost absent due to sediment deposition</li> </ul>				
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	<ul style="list-style-type: none"> <li>4 velocity/depth regimes present</li> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					<ul style="list-style-type: none"> <li>3 Of 4 velocity/depth regimes present</li> <li>If fast/shallow is missing then score lower</li> </ul>					<ul style="list-style-type: none"> <li>2 of 4 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul style="list-style-type: none"> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>				
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	<ul style="list-style-type: none"> <li>&gt;50% substrate favourable for invertebrate colonisation &amp; wide variety of woody debris, riffles, root mats</li> <li>Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover</li> <li>Must not be new or transient</li> </ul>					<ul style="list-style-type: none"> <li>30-50% substrate favourable for invertebrate colonisation</li> <li>Snags/ submerged logs/undercut banks/cobbles</li> <li>Fish cover common</li> <li>Moderate variety of habitat types. Can consist of some new material</li> </ul>					<ul style="list-style-type: none"> <li>10-30% substrate favourable for invertebrate colonisation</li> <li>Fish cover patchy</li> <li>60-90% substrate easily moved by foot</li> <li>Woody debris rare or may be smothered by sediment</li> </ul>					<ul style="list-style-type: none"> <li>&lt;10% substrate favourable for invertebrate colonisation</li> <li>Fish cover rare or absent</li> <li>Substrate unstable or lacking</li> <li>Stable habitats lacking or limited to macrophytes</li> </ul>				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	<ul style="list-style-type: none"> <li>Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton not visible on substrates but obvious to touch</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton visible</li> <li>&lt;20% cover of available substrates</li> </ul>					<ul style="list-style-type: none"> <li>Periphyton obvious &amp; prolific</li> <li>&gt;20% cover of available substrates</li> </ul>				
Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 136																				

## Appendix B Fish surveys

Fish collection form – Wadeable streams/ivers																	
Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Glenys Croker (NIWA)			GPS (d/s): E2728975 N6400407			Site: Mangakahika Stream				Date: 18/02/13							
			GPS (u/s): E2728895 N6400360			Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished						
Fish sample id:	Total shock time (min): 54	Fishing time: Start 10:45 Finish 12:30	Sample distance (m): 150			Wetted width (m):		A 1.5 C 2.0 E 1.2 G 1.1 I 1.6	B 1.2 D 1.1 F 1.0 H 0.9 J 2.0								
Sampling gear: Spotlight EFM Seine		Length (m) Mesh (mm)		Water visibility: Good Average Poor		Water temp. (°C): 16.8		Conductivity (µS): 177									
EFM anode: Big Small		EFM volts (x100): 3		EFM pulse rate (Hz or pps): 60		EFM pulse width (ms): 2		Spotlight (watts):									
Species	A	B	C	D	Sub-reach tally		E	F	G	H	I	J	Total count	Sample count	Length (mm)		FLAG
Banded Kokopu	3	8	6	4					11	5	22	7	66		50	152	
Shortfin Eel	4	3	3	2	2	2			6	7	1	6	36		120	450	
Longfin Eel		1			1						2	1	5		280	1000	
Common Bully	7	6	3	5	3	1			6	4	4	2	41		30	77	
Koura	3								2	2	1	1	9				
FLAG	Comment								FLAG	Comment							

### Fish collection form – Wadeable streams/ivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Glenys Croker (NIWA)		GPS (d/s): E 2729470 N6402548	Site: Riuohauraki Stream				Date: 18/02/13								
		GPS (u/s): E2729382 N6402591	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 54	Fishing time:	Start 14:00 Finish 15:15	Sample distance (m): 150	Wetted width (m):	A 1.8 B 1.5	C 1.1 D 0.8	E 2.5 F 2.2	G 1.6 H 1.2	I 1.7 J 0.8					
Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 20.7	Conductivity (µS): 241.9					
EFM anode:	Big Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):										
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Banded Kokopu									1		1		197	197	
Shortfin Eel	1				1	1	4	1	1		9		100	450	
Longfin Eel		1	3		1	1	1	1		1	9		130	600	
Cran's Bully	7	9	12	19	15						62		32	69	
Elver						1					1		100	100	
Koura	5	4									9				
FLAG	Comment							FLAG	Comment						
	Missed 6 bullies 35-65 mm														

### Fish collection form – Wadeable streams/ivers

Team members: Paul Franklin (NIWA) Josh Smith		GPS (d/s): E 2751431 N 6429122	Site: Paiakarahi Stream D/S				Date: 19/02/13								
		GPS (u/s): E 2751418 N 6429342	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 64	Fishing time: Start 11:00 Finish 13:00	Sample distance (m): 150	Wetted width (m):		A 0.5 C 3.5 E 2.8 G 2.5 I 2.8									
Sampling gear: Spotlight EFM Seine		Length (m)	Water visibility: Good Average Poor		Water temp. (°C): 18.6		Conductivity (µS): 102								
EFM anode: Big Small		EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60		EFM pulse width (ms): 2		Spotlight (watts):								
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Banded Kokopu		1		1		1		1			4		160	191	
Inanga	1			3					1		5		70	83	
Cran's Bully	5	3	5	5	10	6	3	7	4	3	51		25	72	
Torrentfish	1						1				2		69	82	
Shortfin Eel		1	2	3	4			2		4	16		110	350	
Longfin Eel	2	1	3		4	4		1	1		16		140	650	
Elver				1	2		1				4		100	100	
Rainbow Trout							1		3	2	6		81	150	
Parataya				R				R							
Missed Eel	1						1				2		150	250	
Koura	2	2	4	7	6	2	2	7	2	2	36				
FLAG	Comment							FLAG	Comment						

### Fish collection form – Wadeable streams/ivers

Team members: Paul Franklin Josh Smith		GPS (d/s): E2751431 N6429122	Site: Paiakarahi Stream U/S				Date: 19/2/13								
		GPS (u/s): E2751550 N6429031	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 101	Fishing time: Start 14:05 Finish 16:25	Sample distance (m): 150	Wetted width (m):		A 6.0	C 3.8	E 5.3	G 1.5	I 5.1					
Sampling gear: Spotlight EFM Seine		Length (m)	Water visibility: Good Average Poor		Water temp. (°C): 18.6		Conductivity (µS): 102								
EFM anode: Big Small		EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60		EFM pulse width (ms): 2		Spotlight (watts):								
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Banded Kokopu	1			1	2	5		2	1		12		38	185	
Inanga								1			1		90	90	
Cran's bully	9	7	14	9	10	24	2	6	11	10	102		20	92	
Torrentfish		1									1		114	114	
Shortfin Eel	1	2							1	1	5		100	210	
Longfin Eel	1	3	2				1	4	3	2	16		130	650	
Elver	1		1						1		3		100	100	
Rainbow Trout	1							1	1	1	4		80	125	
Koura	9			1	8			1	6	1	26				
FLAG	Comment							FLAG	Comment						
	Reach F-G: 7 m skipped due to deep pool, continued fishing extra 7m to keep total distance 150														

### Fish collection form – Wadeable streams/ivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA)		GPS (d/s): E 2742184E N 6365455	Site: Waitoa Tributary				Date: 20/02/13								
		GPS (u/s): E 2742094 N 6365394	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 96	Fishing time: Start 10:00 Finish 12:50	Sample distance (m): 150	Wetted width (m):		A 1.1 C 1.2 E 1.3 G 1.3 I 1.5									
Sampling gear: Spotlight EFM Seine		Length (m)	Water visibility: Good Average Poor		Water temp. (°C): 18		Conductivity (µS): 126								
EFM anode: Big Small		EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60		EFM pulse width (ms): 2		Spotlight (watts):								
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Cran's bully	15	40	8	3	5	20	13	23	30	18	175		17	160	
Shortfin Eel	7	50	22	18	20	13	25	14	20	10	199		85	400	
Longfin Eel		2	1	2				1	2	2	10		200	900	
Elver	6	8								6	20		85	100	
Koura	6	6	4		3	3	7	4	5		38				
FLAG	Comment							FLAG	Comment						
	Missed 61 bullies														
	Missed 44 elvers														
	Missed 1 SF eel														

### Fish collection form – Wadeable streams/ivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA)		GPS (d/s): E2744443 N6368529	Site: Mangapapa Stream				Date: 20/02/13								
		GPS (u/s): E2744319 N6368540	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 62	Fishing time: Start 14:05 Finish 16:10	Sample distance (m): 150	Wetted width (m):	A 3.2	C 3.5	E 3.8	G 3.0	I 1.7						
Sampling gear: Spotlight EFM Seine		Length (m)	Water visibility: Good	Average	Poor	Water temp. (°C): 19.1	Conductivity (µS): 102								
EFM anode: Big Small		EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):										
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Cran's Bully	9	9	5	22	4	13	7	10	6	1	86		22	65	
Shortfin Eel	3	1	3	1	3	3	1	1			16		85	400	
Longfin Eel		2	2		1		1	2			8		400	850	
FLAG	Comment							FLAG	Comment						
	End of reach D skipped 8m deep water before starting reach E														
	Missed around 55 bullies														
	Missed 1 Elver														
	Koura abundant and common in all reaches														

### Fish collection form – Wadeable streams/ivers

Team members: Josh Smith Aslan Wright-Stow		GPS (d/s): E2758631 N6384786	Site: Karengorengo Stream				Date: 20/02/13								
		GPS (u/s): E2758661 N6384650	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id: Yes	Total shock time (min): 48	Fishing time: Start 10:00 Finish 12:05	Sample distance (m): 150	Wetted width (m): A 2.2 C 2.3 E 2.8 G 3.0 I 3.8		B 2.5 D 2.1 F 2.6 H 2.0 J 2.4									
Sampling gear: Spotlight	EFM	Seine	Length (m)	Water visibility: Good	Average	Poor	Water temp. (°C): 15.2	Conductivity (µS): 188.2							
	Mesh (mm)														
EFM anode: Big	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):											
	Small														
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Common Bully	1	2		2		1	1			1	8		51	58	
Shortfin Eel	19	31	13	15	10	9	12	6	10	11	136		76	600	
Longfin Eel		1						1			2		220	330	
Inanga		2	2	2	1		1		1	2	11		68	95	
Smelt	19	3						8			30		65	87	
Brown Trout	1		2					1			4		130	300	
Koura	6	8	7	8	4	6	6	4	6	3	58				
FLAG	Comment							FLAG	Comment						
	Shrimp common														
	Lots of eels missed due to abundant macrophytes and deep water reaches A, H, I, J														



### Fish collection form – Wadeable streams/ivers

Team members: Josh Smith Paul Franklin		GPS (d/s): E 2727985 N6377350	Site: Waitakaruru Stream				Date: 22/02/13								
		GPS (u/s): E2728142 N6377272	Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished							
Fish sample id:	Total shock time (min): 54	Fishing time: Start 09:20 Finish 11:00	Sample distance (m): 150	Wetted width (m):	A 1.8	C 1.9	E 1.4	G 2.3	I 1.8						
Sampling gear: Spotlight EFM Seine		Length (m)	Water visibility: Good	Average	Poor	Water temp. (°C): 18.6	Conductivity (µS): 135								
EFM anode: Big Small		EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):										
Species	Sub-reach tally										Total count	Sample count	Length (mm)		FLAG
	A	B	C	D	E	F	G	H	I	J			Min.	Max.	
Cran's Bully	7	3	8	8	4	6	7	5	6	2	56		18	60	
Torrentfish								1			1		97	97	
Shortfin Eel	4	7	6	13	10	10	11	10	3	8	82		120	750	
Longfin Eel	1	1					1				3		580	1150	
Koura		2	7	3	2	5	7	1	3	4	34				
FLAG	Comment							FLAG	Comment						
	1 Elver missed														



## Appendix C Macroinvertebrate taxa list

Species	Sites									
	1	2	3	4	5*	6	7	8	9	10
<i>Archichauliodes diversus</i>	8	39	5	9	2	1			7	
<i>Xanthocnemis zealandica</i>								2		
<i>Acanthophlebia cruentata</i>		1 R								
<b>Austroclima sp.</b>	2	3	8	4			1		1	
<i>Austroclima sepia</i>			3	3		7	11		1	
<b>Deleatidium spp.</b>	47	48	20	4		55				
<i>Coloburiscus humeralis</i>	5	2	27	6						
<i>Ichthybotus hudsoni</i>				1						
<i>Neozephlebia scita</i>	12	2								
<i>Nesameletus sp.</i>	2		14	6						
<i>Rallidens Mcfarlanei</i>			1							
<i>Zephlebia spp.</i>		1								
<i>Zephlebia borealis</i>	4	1 R								
<i>Zephlebia dentata</i>	6	3 R				22	24		12	12
<i>Zephlebia inconspicua</i>									1	
<i>Zephlebia spetabilis</i>				1 R						
<i>Zephlebia versicolor</i>							1 R			
<i>Acroperla trivacuata</i>										1
<i>Austroperla cryene</i>			1							1
<i>Megaloptoperla grandis</i>			2							
<i>Zelandoperla decorata</i>			7	1						
<i>Aoteapsyche colonica</i>	18	1 R	12	9					6	6
<i>Aoteapsyche spp.</i>	1	5	26	6		13				
<i>Beraeoptera roria</i>			2	1						
<i>Costachorema spp.</i>			2							
<i>Helicopsyche spp.</i>	12									
<i>Hudsonemia alienum</i>							1			
<i>Hudsonema amabilis</i>	6	5		1		5				
<i>Hydrobiosis spp.</i>	5	5	1	2			2		2	
<i>Hydrobiosis budjei</i>		1 R								

Species	Sites									
	1	2	3	4	5*	6	7	8	9	10
<i>Hydrobiosis copis</i>									2	
<i>Hydrobiosis gollanis</i>	3 R	1								
<i>Hydrobiosis parumbripennis</i>	1			2						
<i>Neurochorema</i> spp.	5			4						
<i>Neurochorema armstrongi</i>				2						
<i>Ocetis unicolor</i>									1	
<i>Olinga feredayi</i>	5					20				
<i>Oxyethira albiceps</i>		2	2	1			6	39	13	
<i>Paroxythira</i> sp.				1				1		
<i>Plectrocnomia maclachani</i>				1						
<i>Psilochorema macroharpax</i>	1									
<i>Psilochorema mimicum</i>		1 R								
<i>Pycnocentria evecta</i>	9		1		1	6				
<i>Pycnocentrodes</i> sp.	10	18	2	5	5	119			52	
<b>Triplectides obsoletus</b>		5	2				10	1 R	1 R	
<i>Aphrophila neozelandica</i>			9	7		1 R	1 R			1
<b>Austrosimulium</b> sp.						2	9		5	8
<i>Chironomus zealandicus</i>									1	
<i>Cricotopus</i> spp.		16	7	3	1		1	57	2	1
Empididae	1	1							1	
<i>Eukiefferiella</i> sp.	1		2	1					1	
<i>Kaniwhaniwhanus</i>			4		1					
Lobodiamesinae					2					
<b>Tanypodinae =Macropelopiini</b> sp.	2	6		13						
<i>Maoridiamesa</i> sp.			8	3	1					
<i>Molophilus</i> sp.										2
Muscidae			1 R	4	2					
<i>Naonella forsythi</i>	3		2	4				11	1	
<i>Paradixa</i> sp.		1					13			
<i>Pirara</i>		7							2	
<i>Polypedilum</i> spp.	2	5					1			
<i>Stictocladius</i> spp.							1			

Species	Sites									
	1	2	3	4	5*	6	7	8	9	10
Tanytarsus spp.	5	25	15	64				38		
<i>Tanytarsus vespertinus</i>									3	
<i>Hygraula nitens</i>								2		
<b>Elmidae (larvae)</b>	5	3	6	18		7			80	1
Ptilodactylidae (larvae)						1				
Ferrissia sp.	1 R									
<i>Gyraulus corinna</i>							1	38		
Latia neritoides					11					
<i>Physa</i> sp.				1				17		
<b>Potamopyrgus antipodarum</b>	37	8	30	42	5	69	115	13	23	22
<i>Eiseniella</i> sp.		1								
Oligochatea	2			1		1 R	2		1 R	
Plathylminthes			1	1		1			5	
Leach								3		
Ostracoda							1 R		2	
<i>Paracorophium</i>										1
<i>Paracalliope fluviatus</i>							17		2	
<i>Paranephropus planiforins</i>										10
Spring tail				1 R						

\* Sample not preserved correctly. Consequent loss of species.

## Appendix D Macrophytes and periphyton

Periphyton Assessment							
Stream: Mangakahika Stream				Date: 18/02/13			
Sample Number: 1				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	30	50	60	80	90	62
Medium mat/film (0.5-3mm thick)	Green (% cover)			5	5	10	4
	Light brown (% cover)						
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Mangakahika Stream			Located number:		Sample Number: 1			Date: 18/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	1.5	1.5	0							
2	2.0	2.4	0							
3	1.2	1.3	0							
4	1.1	1.3	0							
5	1.6	2.1	0							

## Periphyton Assessment

Stream: Riuohauraki Stream		Date: 18/02/13					
Sample Number: 2		Located number:					
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA		20	30	20	40	22
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)	20	40				18
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)	70	20				27
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Riuhauraki Stream			Located number:		Sample Number: 2		Date: 18/02/13			
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	1.8	3.6	0							
2	1.1	4.0	0							
3	2.5	3.2	0							
4	1.2	3.5	0							
5	0.8	3.0	0							

Periphyton Assessment							
Stream: Paiakarahi Stream D/S				Date: 19/02/13			
Sample Number: 3				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	20	10	30	20	20	20
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)		50		20	5	15
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Paiakarahi Stream D/S			Located number:		Sample Number: 3			Date: 19/2/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	1.5	4	0							
2	3.0	4.5	0							
3	2.8	3.5	0							
4	3.5	5.0	0							
5	3.7	4.8	0							

Periphyton Assessment							
Stream: Paiakarahi Stream U/S				Date: 19/02/13			
Sample Number: 4				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	30	50	40	60	50	46
Medium mat/film (0.5-3mm thick)	Green (% cover)					10	2
	Light brown (% cover)		10				2
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)		10				2
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Paiakarahi Stream U/S			Located number:		Sample Number: 4			Date: 19/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	5.0	12.5	0							
2	6.1	10.8	0							
3	5.6	9.7	0							
4	4.5	14.0	0							
5	6.2	14.8	0							

Periphyton Assessment							
Stream: Waitoa Tributary				Date: 20/02/13			
Sample Number: 5				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	40	20	20	10	30	24
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)	30	40		90	40	40
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Waitoa Tributary			Located number:		Sample Number: 5			Date: 20/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	2.0	3.0	0							
2	3.0	3.5	0							
3	2.5	3.4	0							
4	1.0	1.5	0							
5	1.5	2.2	0							

Periphyton Assessment							
Stream: Mangapapa Stream				Date: 20/02/13			
Sample Number: 6				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA					20	4
Medium mat/film (0.5-3mm thick)	Green (% cover)			25		5	6
	Light brown (% cover)	90		10	90	20	42
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)		100				20
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA			10		30	8
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Mangapapa Stream			Located number:		Sample Number: 6			Date: 20/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	3.2	3.5	0							
2	4.0	6.0	0							
3	3.8	4.5	2	2			2	Lm Pk		
4	3.0	7.2	0							
5	3.5	5.1	0							

Periphyton Assessment							
Stream: Karengorengo Stream				Date: 21/02/13			
Sample Number: 7				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	0	0	0	0	0	0
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)						
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Karengorengo			Located number:		Sample Number: 7			Date: 21/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	2.5	4.0	70						70	Na
2	2.5	4.0	50						50	Na
3	2.3	3.5	80						80	Na, Ps
4	3.0	4.5	55						55	Na, Ps
5	2.4	3.8	60						60	Na, Ps

Periphyton Assessment							
Stream: Waiheka Stream				Date: 21/02/13			
Sample Number: 8				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA						
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)						
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)	80	80	90	90	90	86
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

## Macrophyte recording sheet

Stream: Waiheka Stream			Located number:		Sample Number: 8			Date: 21/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	4.1	6.0	85	80				Ec	5	Ph
2	4.2	6.0	100	90				Ec	10	Ph
3	3.8	6.0	100	90				Ec	10	Ph
4	4.1	6.0	95	90				Ec	5	Ph
5	3.8	6.0	100	90				Ec	10	Ph

Periphyton Assessment							
Stream: Waitakaruru Stream				Date: 22/02/13			
Sample Number: 9				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA			20			4
Medium mat/film (0.5-3mm thick)	Green (% cover)						
	Light brown (% cover)	50	60	70	50	60	58
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)					10	2
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)	30					6
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA						
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Waitakaruru Stream			Located number:		Sample Number: 9			Date: 22/02/13		
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	1.5	2.5					2	Ec		
2	1.3	3.0								
3	1.8	3.2								
4	2.0	3.5					5	Ec		
5	2.2	4.0								

Periphyton Assessment							
Stream: Piakonui Stream				Date: 22/02/13			
Sample Number: 10				Located number:			
Thickness category	Colour category	A	B	C	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA		20		20	10	10
Medium mat/film (0.5-3mm thick)	Green (% cover)			30			6
	Light brown (% cover)	50	20		50	60	36
	Black/dark brown (% cover)						
Thick (>3mm) mat/film	Green/light brown (% cover)						
	Black/dark brown (% cover)						
Filaments short (<2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Filaments long (>2cm)	Green (% cover)						
	Brown/Reddish (% cover)						
Submerged bryophytes	NA	10	10	20			8
Iron Bacteria growths	NA						

### Macrophyte recording sheet

Stream: Piakonui Stream			Located number:		Sample Number: 10		Date: 22/02/13			
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)							
			Total cover	Submerged plants				Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
Sub-total	Species	Sub-total	Species							
1	2.5	5	0							
2	2.6	6.5	0							
3	2.7	7.1	0							
4	2.2	6.3	0							
5	3.0	5.8	0							