# Waihou and Piako ecological monitoring 2015



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# Waihou and Piako ecological monitoring 2015

## Prepared for Waikato Regional Council

April 2015



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## Contents

Execu	tive su	ımmary	9
1	Introd	luction	10
2	Meth	odology	11
	2.1	Sites	11
	2.2	Fish	13
	2.3	Macroinvertebrates	13
	2.4	Macrophytes & periphyton	13
3	Result	ts	14
	3.1	Piako catchment	14
	3.2	Waihou catchment	29
4	Discus	ssion	44
	4.1	Piako catchment	44
	4.2	Waihou catchment	44
5	Concl	usions	46
6	Recon	nmendations	47
7	Ackno	wledgements	47
8	Refer	ences	48
Appei	ndix A	Habitat assessment forms	49
Appe	ndix B	Fish surveys	79
Appei	ndix C	Macrophytes and periphyton	89
Appei	ndix D	Macroinvertebrate taxa list	109
Table	S		
Table	2-1:	Location of the 2015 ecological monitoring sites in the Waihou and Piako catchments.	11
Table	3-1:	Results of 2015 electric fishing survey at the five Piako catchment monitoring sites.	16
Table	3-2:	Summary of macroinvertebrate results for the Piako monitoring sites in	

20 2015. Table 3-3: Correlation coefficients between the habitat score and various biotic indices for the Piako catchment. 26 Table 3-4: Results of 2015 electric fishing survey at the five Waihou catchment monitoring sites. 31 Summary of macroinvertebrate results for the Waihou monitoring sites in Table 3-5: 2015. 34 Table 3-6: Correlation coefficients between the habitat score and various biotic indices for the Waihou catchment. 40

#### Figures

Figure 2-1:	Location of the 10 ecological survey sites sampled in the Waihou and Piako	
	catchments during 2014 and 2015.	12

Figure 3-1:	Comparison between the relative abundance of fish captured in the 2012 – 2015 Piako surveys.	17
Figure 3-2:	Length-frequency relationships for the most abundant fish species at each site in the Piako catchment.	18
Figure 3-3:	Comparison of MCI scores between survey years in the Piako catchment.	21
Figure 3-4:	Comparison of macrophyte total cover (MTC) scores over time at the Piako survey sites.	23
Figure 3-5:	Comparison of periphyton enrichment index (PEI) scores over time at the Piako survey sites.	24
Figure 3-6:	Comparison of periphyton sliminess index (PSI) scores over time at the Piako survey sites.	25
Figure 3-7:	Comparison of habitat scores over time for the Piako survey sites.	27
Figure 3-8:	Scatterplot of habitat score against MCI score at the Piako survey sites in different survey years ( $\rho$ =0.51).	28
Figure 3-9:	Comparison between the relative abundance of fish captured in the 2009, 2011, and 2013 - 2015 Waihou surveys.	32
Figure 3-10:	Length-frequency relationships for the most abundant fish species at each site in the Waihou catchment.	33
Figure 3-11:	Comparison of MCI scores between survey years in the Waihou catchment.	35
Figure 3-12:	Comparison of macrophyte total cover (MTC) scores over time at the Waihou survey sites.	37
Figure 3-13:	Comparison of periphyton enrichment index (PEI) scores over time at the Waihou survey sites.	38
Figure 3-14:	Comparison of periphyton sliminess index (PSI) scores over time at the Waihou survey sites.	39
Figure 3-15:	Comparison of habitat scores over time for the Waihou survey sites.	41
Figure 3-16:	Scatterplot of habitat score against MCI score at the Waihou survey sites in different survey years (ρ=0.44).	42
Figure 3-17:	Scatterplot of habitat score against fish species richness at the Waihou survey sites in different survey years ( $\rho$ =0.69).	43

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## **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 Waihou and Piako catchments to support and inform the scheduled water allocation review process in these catchments. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems.

The scope of this study was to undertake monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. Five sites were to be surveyed in each catchment. The aim was to build on and consolidate the previous ecological monitoring studies in the catchments by adding to the time series of data for these sites.

The results of this survey indicate that, at the Piako survey sites, the relative abundance of fish was generally lower in 2015 than in 2014 except in the Mangapapa site, where more shortfin and longfin eels, as well as Cran's bullies, were observed in 2015. Inanga continued to be absent from all five sites (compared with being present at two of the sites in 2012). In the Waihou, the relative abundance of most fish species was also lower in 2015 than in 2014 at four of the five sites. In the Waiteariki site, however, relative abundances of all species except brown trout were higher in 2015 than 2014. Banded kokopu were only found in one site in the Waihou catchment in 2015, whereas in 2014 they were observed in three sites.

Macroinvertebrate communities in the Piako sites improved in total taxonomic richness relative to previous surveys. Proportion EPT and MCI scores were more variable, declining in some sites and improving in others. In the Waihou catchment, macroinvertebrate communities also had greater taxonomic richness than in previous surveys, while %EPT remained similar. MCI scores, however, declined at two sites. In both catchments, the sites with declining macroinvertebrate communities had lower habitat quality scores, primarily due to a reduction in riparian vegetation and increased stream bank erosion or increased macrophyte and periphyton cover. In general, these impacts are associated with a reduction in the quality and diversity of the aquatic communities at these sites.

It is recommended that annual ecological monitoring continues at these ten sites. This will help to determine the inter-annual variability of native fish and macroinvertebrate populations over time, thus providing a more robust baseline against which to monitor the effects of human impacts on these river ecosystems over time. To improve the spatial coverage of the monitoring, it may be valuable to introduce a further group of sites for monitoring once every 3-5 years. This ecological monitoring will support WRC in setting appropriate, targeted and robust freshwater objectives and associated protection levels in the Waihou and Piako catchments.

## 1 Introduction

The Waikato Regional Council (WRC) is responsible for managing the status of water resources in the Waikato region. WRC's approach to the protection, management and use of water resources is set out in the Waikato Regional Plan (Waikato Regional Council 2012), hereafter referred to as the Plan. As required by the National Policy Statement for Freshwater Management (MfE 2011), the Plan includes minimum flow and allocation limits for all catchments in the region (Table 3-5; Waikato Regional Council 2012). Scheduled reviews of the flow and allocation limits are also specified in the Plan (Table 3-4A; Waikato Regional Council 2012).

WRC have initiated investigations in the Waihou and Piako catchments to support and inform the scheduled allocation review process in these catchments. One of the key objectives of the water allocation process is to safeguard the life-supporting capacity of freshwater ecosystems (MfE 2014). WRC are seeking to improve their understanding of the ecological status of aquatic ecosystems in the Waihou and Piako river systems and have initiated ecological monitoring studies in the two catchments (Franklin and Booker 2009; Franklin et al. 2011; Franklin and Bartels 2012; Franklin et al. 2013; Franklin et al. 2014).

The objective of this study was to undertake monitoring of fish, macroinvertebrates, macrophytes and periphyton at ten sites across the Waihou and Piako catchments. Five sites were chosen for annual surveying in each catchment based on the recommendations in Franklin et al. (2013). The aim was to build on and consolidate the previous ecological monitoring studies in the catchments by adding to the time series of data for these sites. The results will contribute knowledge of the ecological values in the catchments to the water allocation decision-making process.

## 2 Methodology

## 2.1 Sites

Monitoring was carried out at ten sites in early March 2015 during a period of sustained summer low flows (Table 2-1 & Figure 2-1). The sites were those sampled in 2014 following the recommendations of Franklin et al. (2013). The 2014 sampling had also been conducted in early March; consistency in sampling time is required for accurate comparisons of size distributions between years. All sites other than Site 10 on the Waitawheta River had also been sampled at least once prior to 2014. Site 10 was established in 2014 as a new site in the Ohinemuri sub-catchment, downstream of the Ohinemuri weir which is considered a barrier to upstream migration of most fish species.

Table 2-1:Location of the 2015 ecological monitoring sites in the Waihou and Piako catchments.Easting and Northing given for downstream limit of survey reach (NZTM coordinates).

Site	Catchment	Stream	Easting	Northing	Distance inland (km)	Elevation (m)
1	Piako	Mangakahika Stream	1818698	5838814	59	62
2	Piako	Waitoa Stream	1831974	5803819	125	157
3	Piako	Mangapapa Stream	1836783	5809932	107	86
4	Piako	Waitakaruru Stream	1817745	5815748	92	63
5	Piako	Piakonui Stream	1831211	5815768	100	160
6	Waihou	Paiakarahi Stream D/S	1841027	5867879	34	60
7	Waihou	Karengorengo Stream	1848393	5823235	100	30
8	Waihou	Wairere Stream	1851649	5819801	108	40
9	Waihou	Waiteariki Stream	1852566	5818150	112	97
10	Waihou	Waitawheta River	1845480	5849662	71	177

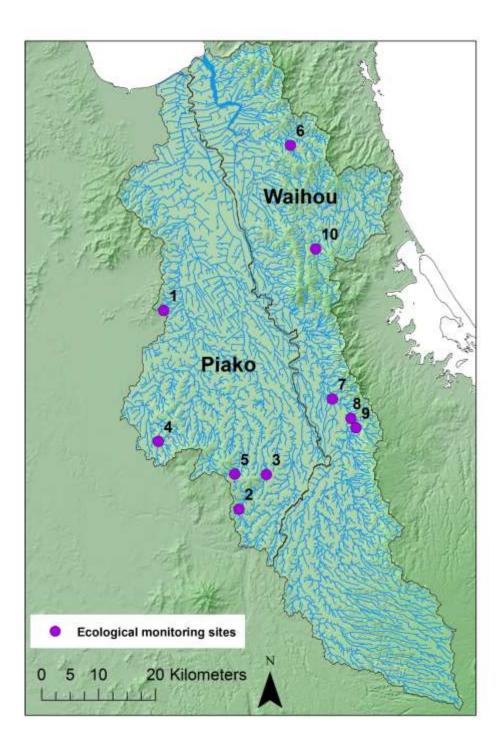


Figure 2-1:Location of the 10 ecological survey sites sampled in the Waihou and Piako catchments during2014 and 2015.Site numbers refer to those listed in Table 2-1.

## 2.2 Fish

Fish surveys were carried out by electric fishing using the standardised methods outlined by WRC (David and Hamer 2010). At each site, a 150 m reach was surveyed by single pass electric fishing using an EFM300 with voltage adjusted dependent on local conditions. In each site, the same voltage was used in both 2014 and 2015. Electric-fishing effort was standardized between years by matching the duration of time the electric-fishing machine was operating during each sampling. 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 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 and 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 (Stark et al. 2001). For hard-bottomed streams, a kick-sampling approach targeting riffle areas and following MfE Protocol C1 was utilised (Stark et al. 2001). At each site the WRC REMS (Regional Ecological Monitoring of Streams) 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 counts and scan for rare taxa) (Stark et al. 2001). This provides proportional abundance data suitable for the calculation of most invertebrate parameters (Collier and Kelly 2005). Complete taxonomic lists were compiled and a range of community metrics calculated at the taxa level indicated in Collier and 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), Periphyton Sliminess Index (PSI) and a range of periphyton biomass indices as defined in 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 Piako catchment

#### 3.1.1 Fish

All six of the native fish species recorded across the five survey sites in the Piako catchment during the 2014 survey were captured in 2015 (Table 3-1). No exotic species were captured even though they are known to be locally abundant in some areas of the Piako catchment. Shortfin eels (*Anguilla australis*) were present at all five sites, while longfin eels (*Anguilla dieffenbachii*) were only present at three sites (compared to five sites in 2014). Koura (*Paranephrops planifrons*), the freshwater crayfish, were recorded in four sites, whereas they were found in all five sites in 2014. Bullies were present at all sites in 2015, as they had been in 2014, with common bullies (*Gobiomorphus cotidianus*) present at the sites on the Mangakahika and Piakonui Streams, and Cran's bullies (*Gobiomorphus basalis*) recorded at the sites on the Waitoa, Mangapapa and Waitakaruru Streams. Similar to 2014, banded kokopu (*Galaxias fasciatus*) were captured in the Mangakahika and Piakonui, and torrentfish (*Cheimarrichthys fosteri*) were found in the Waitakaruru. Inanga (*Galaxias maculatus*) were absent from all five sites, although they were recorded at two sites (Mangapapa and Waitoa) in 2012.

The relative abundance of fish was lower in 2015 than in 2014 in Mangakahika Stream, Waitoa Stream, and Waitakaruru Stream, but higher in Mangapapa and Piakonui Streams (Figure 3-1). In the preparation of this year's report a mistake was discovered in the data entry for the 2014 surveys. As a consequence, the high abundances reported in Franklin et al. (2014) were erroneous. These data have been corrected in the current report and the results presented in Figure 3-1 should be used in future as the reference for fish abundance trends in the Piako catchment.

Species richness was lower in two sites, the Waitakaruru and the Waitoa, in 2015 compared to 2014 due to no longfin eels being caught at either site in 2015. Koura were common but had lower relative abundance in all sites compared to 2015. Koura were absent from the Mangakahika in 2015, although they were present in that site in 2014.

Fish length data provide information on fish recruitment and survival rates. A comparison of lengthfrequency relationships in 2014 and 2015 for shortfin eels and the two bully species at the Piako survey sites are shown in Figure 3-2. The remaining species were not captured in sufficient numbers for development of length-frequency relationships.

The abundance of shortfin eels was highest at the Waitoa site, followed by the Mangapapa and Waitakaruru sites, respectively. In 2014, the populations at these sites were dominated by eels <200 mm in length; in 2015 there were greater numbers of larger eels (200-400 mm in length) at most sites, particularly in the Waitakaruru (Figure 3-2). However, in 2015 elvers (juvenile eels) were often recorded as a unique category as they were too small to be identified as shortfins or longfins in the field (Table 3-1). Consequently, abundances of eels in the smallest size classes may be slightly under-represented in Figure 3-1, although unidentified elvers typically were a small proportion of the total eel abundance in each site (Table 3-1). In future surveys, a new technique developed by Waikato Regional Council using a mini aquarium will be employed to identify elvers >70 mm in the field.

The size distribution of shortfin eels was left-skewed in most sites, due to greater numbers of smaller eels than larger eels. This was particularly apparent for the 200-400 mm size class. This is considered consistent with habitat constraints (i.e., lack of large pools for large eels) and/or

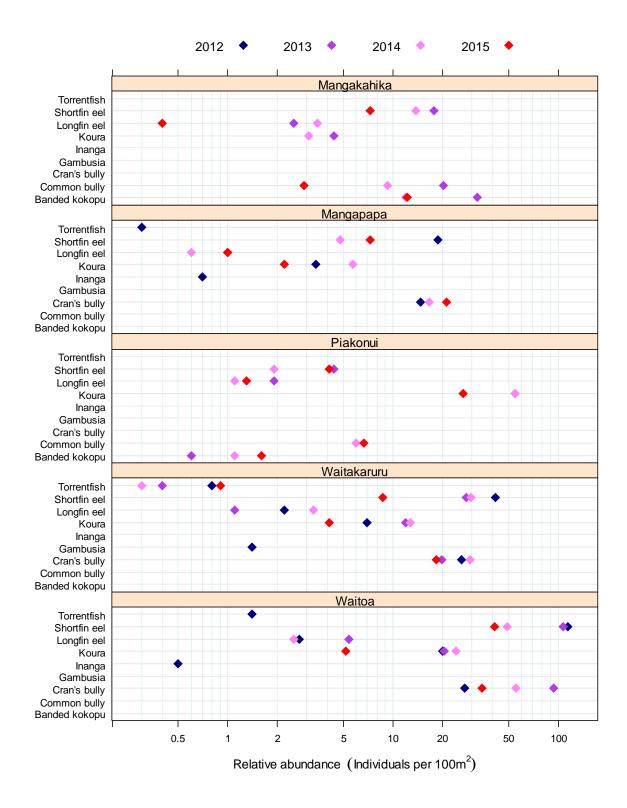
downstream migration of adult male eels, which typically migrate at between 350-500 mm in length (Todd 1980). The Piakonui site, on the other hand, had no large eels, but more eels <200 mm in 2015 than in 2014 (Figure 3-2). This suggests that while juvenile recruitment is occurring in the Piakonui, habitat conditions may not be suitable at this site for supporting large eels. Intraspecific competition and commercial or traditional harvest pressure may also be factors that could contribute to reducing the number of large eels at this site.

There were fewer juvenile (<30 mm) Cran's bullies, more large adults (>50 mm) and a greater proportion of adults in the population at the three sites (Mangapapa, Waitakaruru and Waitoa) where they are present in 2015, compared to 2014 (Figure 3-2). This indicates lower recruitment than the previous year, but increased survival of adults. At the two sites where common bullies were present (Mangakahika and Piakonui), the size structure of the population varied between 2014 and 2015, which is likely to be due to the diadromous lifecycle of this species where recruitment can be inconsistent between years. For example, there were more juveniles in the Mangakahika in 2015 than in 2014. In contrast, there were fewer small fish and more large fish in the Piakonui in 2015 than in 2014. This suggests that this population is primarily sourced by migration/re-distribution within the stream, rather than recruitment, a conjecture supported by the absence of common bullies in the Piakonui prior to 2014.

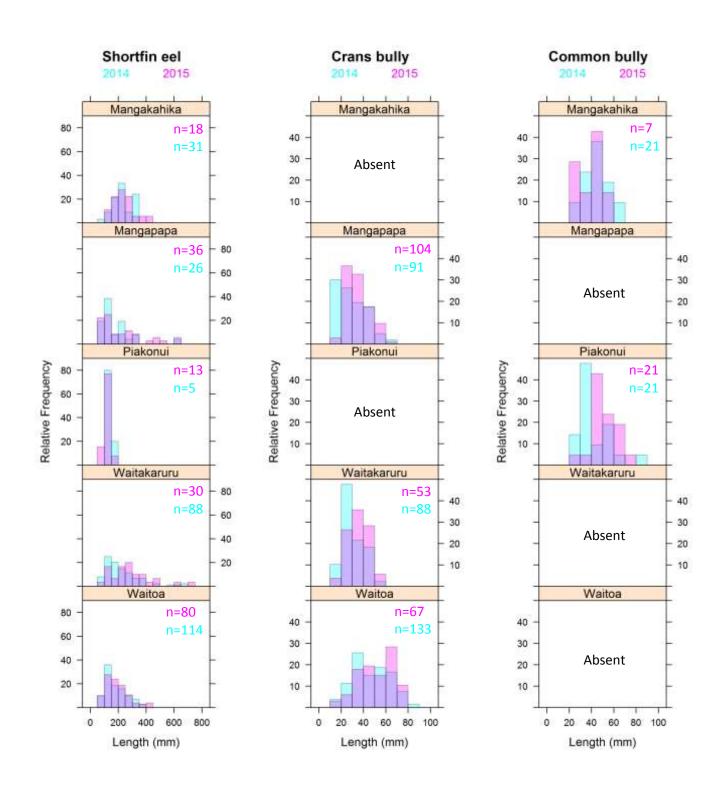
Longfin eels were only present in low numbers at all sites and the majority of those captured were >400 mm in length. Compared to the shortfin eel populations in the Piako, the smaller size classes appear to be significantly under-represented in the longfin eel population, which may relate to either poor recruitment of this species, or an artefact of the limited sampling, as longfin elvers tend to be more discrete in their distribution compared to shortfins.

Table 3-1:Results of 2015 electric fishing survey at the five Piako catchment monitoring sites.Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m<sup>2</sup>).The results from the 2015 survey are in blue; the results from the 2014 survey are included in black for comparison.

Cite	Shortfin eel		Longfin eel		Elver		Cran's bully		Common bully		Torrentfish		Banded kokopu		Koura	
Site	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.	Ab.	Rel. Ab.
1. Mangakahika Stream	18	7.3	1	0.4	3	1.2	-	-	7	2.9	-	-	30	12.2	-	-
	31	13.7	8	3.5	-	-	-	-	21	9.3	-	-	27	11.9	7	3.1
2. Waitoa Stream	80	41.3	-	-	22	11.4	67	34.6	-	-	-	-	-	-	10	5.2
	120	49.1	6	2.5	-	-	135	55.2	-	-	-	-	-	-	59	24.1
3. Mangapapa Stream	36	7.3	5	1	7	1.4	104	21	-	-	-	-	-	-	11	2.2
	26	4.8	3	0.6	-	-	91	16.6	-	-	-	-	-	-	31	5.7
4. Waitakaruru Stream	30	8.7	-	-	4	1.2	63	18.3	-	-	3	0.9	-	-	14	14.1
	89	29.7	10	3.3	-	-	88	29.3	-	-	1	0.3	-	-	38	12.7
5. Piakonui Stream	13	4.1	4	1.3	6	1.9	-	-	21	6.7			5	1.6	83	26.5
	7	1.9	4	1.1	-	-	-	-	22	6.0	-	-	4	1.1	200	54.6



**Figure 3-1:** Comparison between the relative abundance of fish captured in the 2012 – 2015 Piako surveys. The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013. Note the logarithmic x-axis.



**Figure 3-2:** Length-frequency relationships for the most abundant fish species at each site in the Piako catchment. Relative frequency (proportion of total individuals) size distributions for 2014 are shown in blue and size distributions for 2015 are shown in pink. The purple areas indicate where distributions overlapped between the two years.

#### 3.1.2 Macroinvertebrates

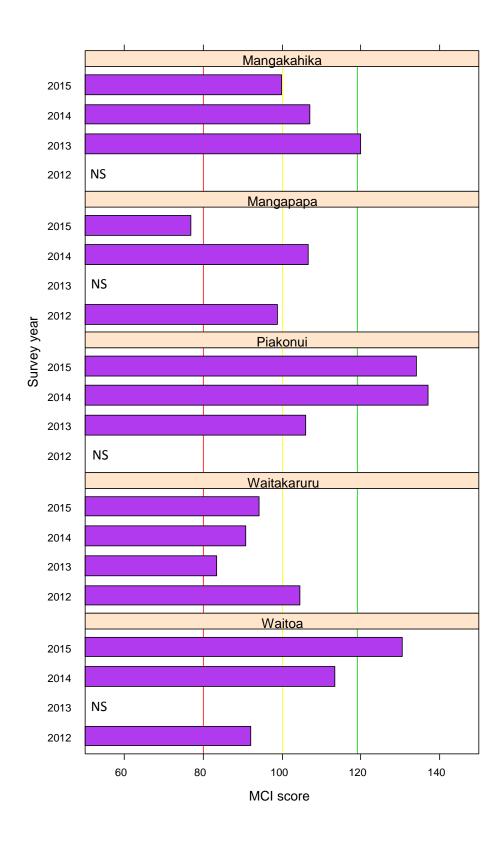
All sites were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m<sup>2</sup> sampled at each site. A full taxonomic list for each site is included in Appendix D and is summarised at the taxa level in Table 3-2 according to the methods and requirements of Collier and 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. Benthic invertebrates such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) collectively known by the acronym EPT are widely utilised as bio-indicators in freshwater ecosystems due to their 'heightened sensitivity' to habitat degradation or pollution. Pristine or native forest habitats typically have greater biodiversity and a higher proportion of these types of sensitive species than intensively developed (i.e., pasture) catchments (Boothroyd and Stark 2000). 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), in contrast, was developed as an indicator of the tolerance of macroinvertebrate communities to organic pollution (Stark and Maxted 2007) and therefore provides a complementary measure of stream health. 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 and Maxted 2007).

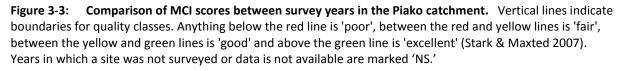
Invertebrate taxa richness was higher at all sites in 2015 compared to 2014, with the greatest increases in the Mangakahika, Mangapapa, and Piakonui sites (Table 3-2). MCI scores at those sites, however, were lower in 2015 than 2014, indicating that the additional species were pollution-tolerant and thus the increased richness was not necessarily indicative of improvements in water quality.

As in 2014, the Piakonui site had the highest total taxa richness and EPT richness in 2015; the %EPT and MCI scores were also highest at this site (Table 3-2). The Mangapapa site had the lowest taxonomic richness in both 2014 and 2015 (Table 3-2), which is likely to be because of the high proportion of bedrock substrate at this site. However, both the number of EPT taxa and the %EPT in the Mangapapa were higher in 2015 than 2014, particularly %EPT, indicating an improvement in the macroinvertebrate community, despite a 'poor' MCI score (Figure 3-3). MCI scores varied only slightly between 2014 and 2015 in the Piakonui and the Waitakaruru survey sites, which remained 'excellent' and 'fair,' respectively (Figure 3-3). The MCI score declined from 'good' to 'fair' in the Mangakahika and from 'good' to 'poor' in the Mangapapa. The Waitoa site MCI score, on the other hand, improved from 'good' to 'excellent' between 2014 and 2015 (Figure 3-3). The improved MCI score in the Waitoa site may be linked to the reduced coverage by aquatic macrophytes observed in this site in 2015 (see Figure 3-4).

Table 3-2:Summary of macroinvertebrate results for the Piako monitoring sites in 2015. The results from2015 are in blue; the results from the 2014 survey are included in black for comparison. MCI scores less than80 are classified as 'poor,' scores 80-100 are 'fair,' scores 100-120 are 'good,' and scores greater than 120 areconsidered 'excellent' (Stark & Maxted 2007).

Site	Total taxa richness	EPT richness	%EPT	MCI
1. Mangakahika Stream	27	10	24.1	100
	20	11	58.7	107.0
2. Waitoa Stream	17	11	77.2	130.6
	15	10	69.9	113.3
3. Mangapapa Stream	13	8	38.7	76.9
	9	6	2.0	106.7
4. Waitakaruru Stream	14	7	15.9	94.3
	13	5	38.6	90.8
5. Piakonui Stream	34	20	86.8	134.1
	28	15	83.5	137.1

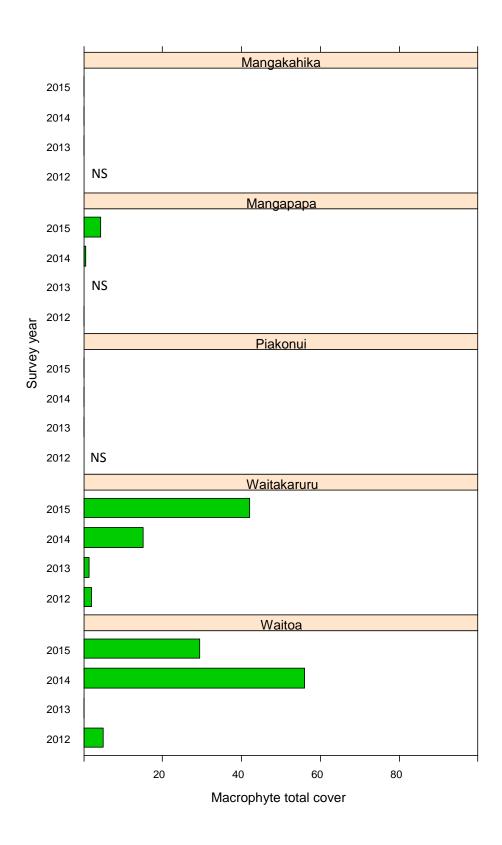




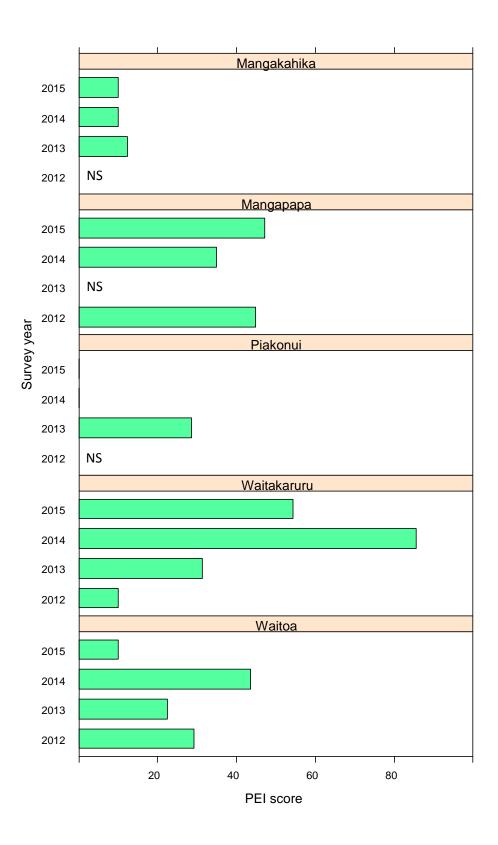
#### 3.1.3 Macrophytes & periphyton

Three of the five sites have no or low macrophyte cover present (Figure 3-4). However, in the Waitakaruru site, there was a significant increase in the macrophyte cover in 2015 compared to 2014, which was in turn greater than in previous years (Figure 3-4). The increase in macrophyte cover in the Waitakaruru was largely due to expansion of submerged exotics *Lagarosiphon major* and *Potamogeton crispus*. The Waitoa site, on the other hand, had lower macrophyte cover in 2015 than 2014, although macrophyte cover in 2015 was still significantly higher than it had been in years prior to 2014. The predominant macrophyte cover in the Waitoa in both 2014 and 2015 was watercress (*Nasturtium officinale*).

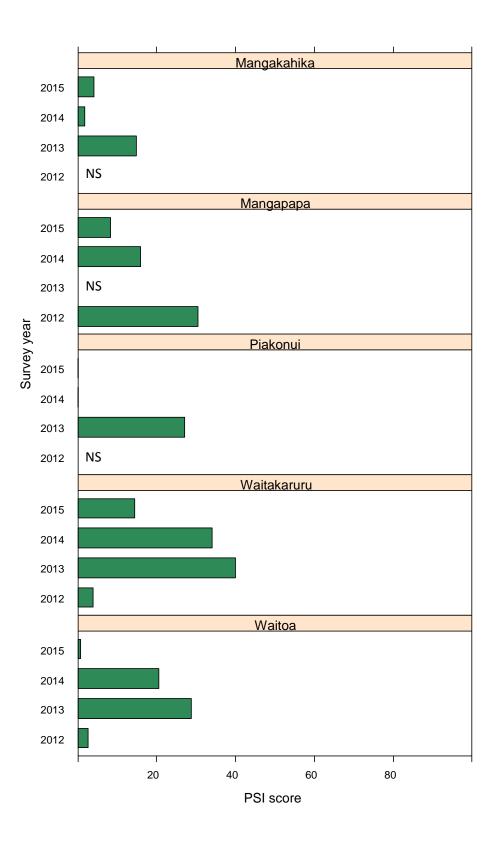
The periphyton enrichment (PEI) and sliminess (PSI) indices have remained relatively stable over time at the Piakonui, Mangakahika and Mangapapa sites (Figure 3-5 & Figure 3-6). In the Waitakaruru and Waitoa sites, the PEI scores were significantly higher in 2014 than in previous years, but decreased again between 2014 and 2015 (Figure 3-5). In the Waitakaruru, the 2015 PEI score was still higher than in all other previous years except 2014 (Figure 3-5). Given the concurrent increase in macrophyte growth at this site, this may be indicative that increasing eutrophication (nutrient enrichment) is occurring in this stream. However, in the Waitoa, the PEI score for 2015 was the lowest yet recorded for that site. Macrophyte cover also declined in the Waitoa between 2014 and 2015, indicating that the effects of eutrophication may have slowed at this site. The PSI scores were significantly lower in both sites in 2015 compared to 2014, largely due to decreased amounts of filamentous algae.

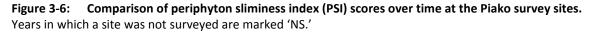


**Figure 3-4:** Comparison of macrophyte total cover (MTC) scores over time at the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'



**Figure 3-5:** Comparison of periphyton enrichment index (PEI) scores over time at the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'





#### 3.1.4 Habitat quality scores

The habitat assessment scores provide a composite index of both reach scale and biotic characteristics of the stream, which can be used as an indicator of habitat quality. Full details of the habitat assessment results are included in Appendix A.

The habitat scores for the Mangapapa and Piakonui sites have remained relatively stable between surveys to date (

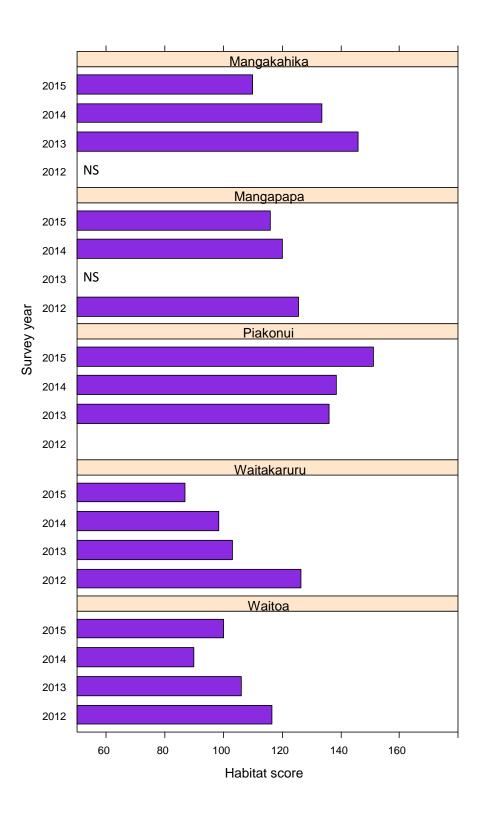
Figure 3-7). However, there has been a gradual decline in scores in the Mangakahika and Waitakaruru sites (

Figure 3-7). Both of these sites lack adequate fencing to prevent stock from accessing the stream. The lower habitat scores were primarily caused by decreases in riparian vegetation and increased stream bank erosion. The Waitoa site habitat scores were also declining until 2014, but improved slightly in 2015. This improvement was largely due to increased bank stability, potentially indicating less damage by cattle, although fencing is also absent at this site.

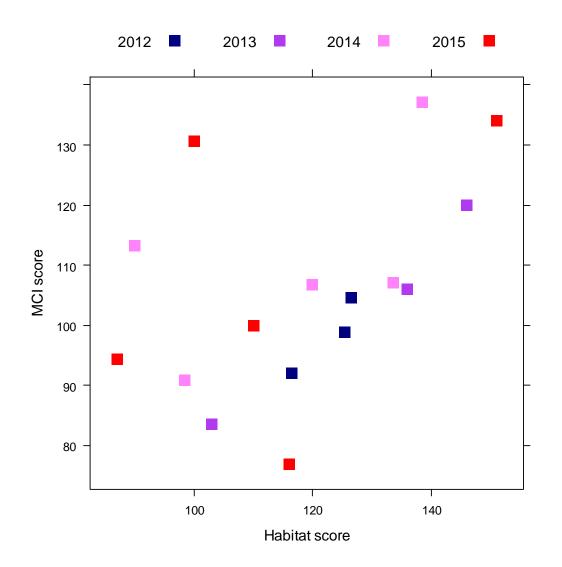
Correlations between habitat score and biotic indices were evaluated using the non-parametric Spearman's rank correlation ( $\rho$ ). Samples from all survey years were pooled (n=16). The macroinvertebrate indices all correlated positively with the habitat score indicating a general improvement in macroinvertebrate communities with increasing habitat score. There was a modest correlation between the habitat score and MCI score ( $\rho$ =0.51; Figure 3-8). In both 2014 and 2015, the Waitoa site had low habitat scores but high MCI scores, suggesting that this site may be a potential outlier, and that the low habitat scores are not associated with organic pollution. The correlations between habitat score, total macroinvertebrate richness and fish species richness were also positive, although not as strong ( $\rho$ =0.38 and  $\rho$ =0.42, respectively; Table 3-3).

## Table 3-3:Correlation coefficients between the habitat score and various biotic indices for the Piako<br/>catchment.

Biotic index	Spearman's rank correlation coefficient
MCI	0.51
Macroinvertebrate total richness	0.38
EPT richness	0.45
% EPT	0.33
Fish richness	0.42



**Figure 3-7:** Comparison of habitat scores over time for the Piako survey sites. Years in which a site was not surveyed are marked 'NS.'



**Figure 3-8:** Scatterplot of habitat score against MCI score at the Piako survey sites in different survey years (ρ=0.51). No MCI score was available for the Waitoa site in 2013.

## 3.2 Waihou catchment

#### 3.2.1 Fish

Ten different fish species were recorded among the five Waihou survey sites in 2015, eight of which were native alongside two exotic species; rainbow and brown trout (Table 3-4). Shortfin eels were the only species present at all five sites, with longfin eels and brown trout (*Salmo trutta*) all recorded at four sites. Koura (freshwater crayfish), were also present at all five sites and freshwater shrimp (*Paratya curvirostris*) were found at two sites. Banded kokopu were only captured at one site in 2015, compared to three sites in 2014. However, inanga were found at two sites in 2015, an increase from one site in 2014. The greatest species richness (8) was recorded in the Paiakarahi survey site, where shortfin eels, longfin eels, Cran's bully, torrentfish, inanga, banded kokopu, rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) were captured (Table 3-4). The greatest abundance of fish was recorded from the Wairere Stream site, where large numbers of both shortfin eels and common bullies were captured, although less than half as many as were recorded in 2014. (*Authors' note:* the abundances for 2014 have been corrected from last year's report, and Figure 3-9 from this report should be used in future as the reference for fish abundance trends in the Waihou catchment).

The relative abundance of fish is compared between survey years for each site in Figure 3-9. A high abundance of macrophytes at the Karengorengo Stream site severely inhibited electric fishing in 2014; it was suspected that the low abundances recorded that year were underestimates caused by the low capture efficiency. Macrophyte cover at this site in 2015 was about half of that recorded in 2014 and more comparable to the 2009 to 2013 surveys (Figure 3-12). Consequently, the numbers of fish captured in 2015 were higher than those seen in 2014 and more comparable to that recorded in earlier surveys. However, the reduced macrophyte cover was not associated with increased capture of longfin eels (none present in 2015) or inanga (one present in 2015), both of which were found in surveys prior to 2014.

At the Paiakarahi sampling site, the abundance of torrentfish, banded kokopu, rainbow trout, and Cran's bullies were lower in 2015 than in any of the previous surveys (Figure 3-9). However, both shortfin and longfin eel abundances in the Paiakarahi in 2015 were comparable to those observed in past years. Brown trout were also found for the first time at this site.

At the Wairere Stream site, the abundance of both shortfin eels and common bullies was lower in 2015 than in 2014, when large numbers of juvenile fish were captured, but higher than the other previous survey in this site (Figure 3-9). However, greater numbers of torrentfish and brown trout were caught in 2015 compared to 2014. Longfin eel abundances were lower than in all previous surveys, and inanga continued to be absent (only recorded in the 2011 survey).

At the Waiteariki survey site, the numbers of fish recorded in 2015 were generally similar to those in both previous surveys (Figure 3-9). Shortfin eel, Cran's bully, and torrentfish abundances were all higher in 2015 than in 2014. Fewer brown trout were caught in 2015, but rainbow trout were observed for the first time. Banded kokopu were absent again after being recorded for the first time in 2014.

At the Waitawheta site, fewer shortfin eels, but more longfin eels were recorded in 2015 compared to 2014. Koura abundance was also substantially higher than the previous year. Brown trout abundance, however, was lower in 2015, and no banded kokopu were captured (a single individual was caught in 2014).

Length-frequency relationships show that there were fewer shortfin eels in the smallest size classes and more in the 150-250 mm size range at all sites in 2015 compared to 2014 (Figure 3-10). At the Wairere site, 34 juvenile eels were identified only as 'elvers,' and therefore the smallest size class for one or both eel species may be under-represented in this site. There were very few shortfin eels >250 mm at any site. Given the presence of large longfin eels at most of these sites, this suggests that instream habitat may be more suited to longfin eels (i.e. hard substrate) rather than shortfin eels.

The longfin eel populations at each site were primarily comprised of fish of >300 mm in length. In combination with the scarcity of longfin elvers (only 3 longfin eels <200 mm were caught; 2 in the Paiakarahi and 1 in the Waiteariki), this may be an indicator of poor recruitment of this species in recent years.

There were more small (<30 mm) bullies of both species in 2015 than 2014 in all but one site, indicating good juvenile recruitment (Figure 3-10). However, there were also fewer large bullies (>70 mm) in 2015, suggesting decreased survival. This could be a consequence of the relatively low flows noted at several sites, but may also reflect natural inter-annual variations in recruitment and population structure. At the Wairere site, there were fewer small bullies and more in the 30-60 mm size range in 2015 compared to 2014. This reflects the high abundance of juvenile bullies at this site in 2014, now in the 30-60 mm size class, which would naturally reduce in numbers over time as they grow. The relative abundance of bullies in the Wairere stream was much lower in 2015 than in 2014.

#### Table 3-4:

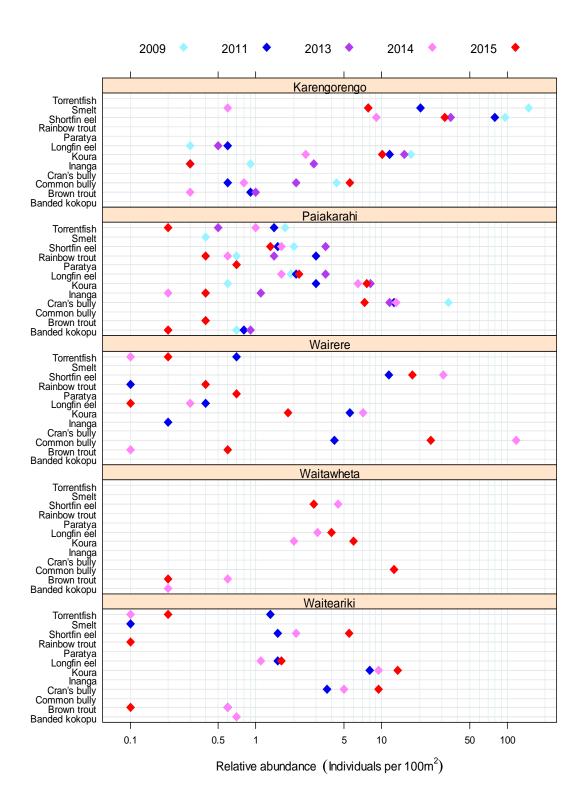
 

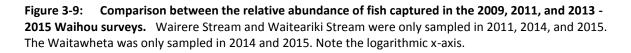
 Fable 3-4:
 Results of 2015 electric fishing survey at the five Waihou catchment monitoring sites.

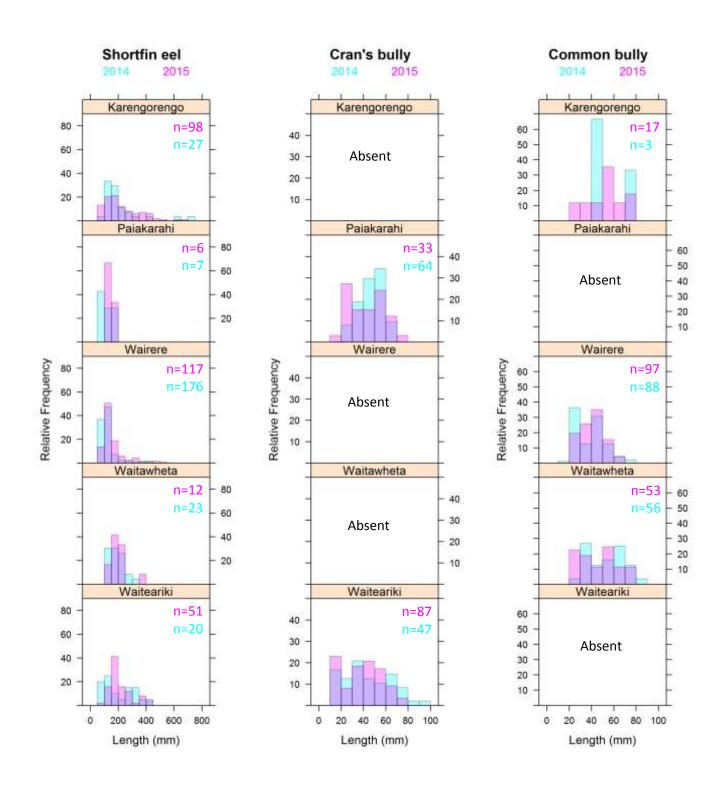
 Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m<sup>2</sup>). The results from 2015 are in blue; the results from the 2014 survey are included in black for

 comparison.

<b>C</b> 11.	Short	fin eel	Long	fin eel	El	ver	Cran'	s bully		imon illy	Torre	entfish	Ina	nga	Sm	nelt		nded Kopu		nbow out	Brow	n trout		dent. out	Ko	oura
Site	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.	Ab.	Rel. Ab.	Ab.	Rel. Ab.
6. Paiakarahi Stream	6	1.3	10	2.2	-	-	33	7.3	-	-	1	0.2	2	0.4	-	-	1	0.2	2	0.4	2	0.4	-	-	34	7.6
	8	1.6	8	1.6	-	-	64	13	-	-	5	1	1	0.2	-	-	1	0.2	3	0.6	-	-	-	-	32	6.5
7. Karengorengo Stream	98	32	-	-	-	-	-	-	17	5.6	-	-	1	0.3	24	7.8	-	-	-	-	-	-	4	1.3	31	10.1
	33	9.1	-	-	-	-	-	-	3	0.8	-	-	-	-	2	0.6	-	-	-	-	1	0.3	-	-	9	2.5
8. Wairere Stream	148	17.5	1	0.1	34	4	-	-	208	24.6	2	0.2	-	-	-	-	-	-	3	0.4	5	0.6	-	-	15	1.8
	254	31.1	2	0.3	-	-	-	-	965	118	1	0.1	-	-	-	-	-	-	-	-	1	0.1	-	-	58	7.1
9. Waiteariki Stream	51	5.5	15	1.6	-	-	87	9.4	-	-	2	0.2	-	-	-	-	-	-	1	0.1	1	0.1	-	-	125	13.5
	20	2.1	10	1.1	-	-	47	5	-	-	1	0.1	-	-	-	-	7	0.7	-	-	6	0.6	-	-	88	9.4
10. Waitawheta River	12	2.9	17	4	-	-	-	-	53	12.6	-	-	-	-	-	-	-	-	-	-	1	0.2	-	-	25	6
	23	4.5	16	3.1	-	-	-	-	64	12.6	-	-	-	-	-	-	1	0.2	-	-	3	0.6	-	-	10	2.0







**Figure 3-10:** Length-frequency relationships for the most abundant fish species at each site in the Waihou catchment. Relative frequency (proportion of total individuals) for 2014 are shown in blue and size distributions for 2015 are shown in pink. The purple areas indicate where distributions overlapped between the two years.

#### 3.2.2 Macroinvertebrates

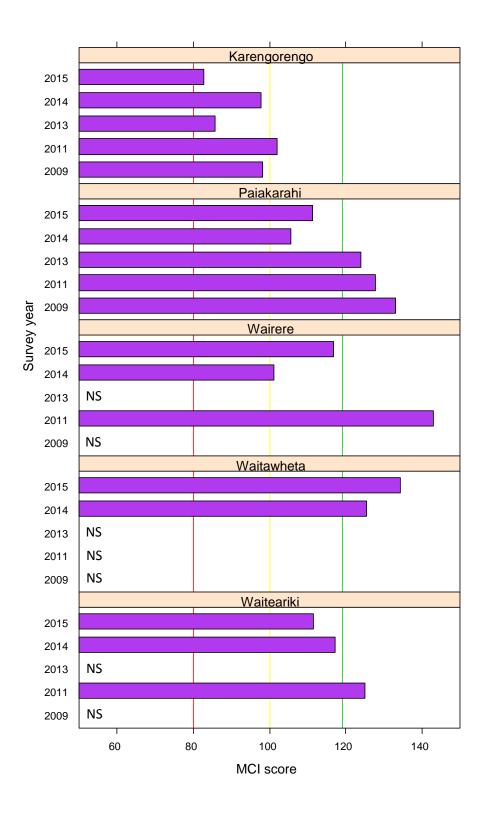
Taxa richness was good at all Waihou sites, and the 2015 richness was the highest yet recorded in four of the five sites (Table 3-5). However, %EPT scores were relatively low for the Waitawheta and Karengorengo sites, due to the high abundance of *Potamopyrgus* in these sites. Nonetheless, the Waitawheta site the highest MCI score and was the only site to fall in the 'Excellent' quality class in both 2015 and 2014 (Figure 3-11).

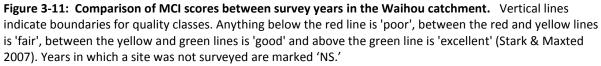
MCI scores improved in the Paiakarahi and Wairere sites; both these sites were in the 'Good' class. Total taxa richness and EPT richness also doubled in both these sites between 2014 and 2015. The MCI score for the Waiteariki site declined slightly between 2014 and 2015, but stayed in the 'Good' quality class. The Karengorengo site MCI score was also lower in 2015, though it retained its 'Fair' classification (Figure 3-11).

The low MCI score for the Paiakarahi site in 2014 was attributed to increased periphyton cover, which is supported by this year's data, as periphyton cover was reduced (Figure 3-13) and the MCI score improved. However, the Wairere site also had an improved MCI score despite an increase in periphyton cover in the reach, and the Waiteariki site score declined despite having much lower periphyton in 2015. This indicates that periphyton cover may not be the main factor driving changes in MCI scores. At the Karengorengo site, changes in habitat are likely to be a contributing factor to the decline in the MCI score. The habitat score also dropped substantially between 2014 and 2015 at this site, due to reduced riparian vegetation and corresponding stream bank instability and erosion.

Site	Total taxa richness	EPT richness	%EPT	MCI
6. Paiakarahi Stream	32	19	61.6	111.3
	18	9	50.2	105.6
7. Karengorengo Stream	22	7	22.1	82.7
	18	7	22.1	97.8
8. Wairere Stream	32	20	51.2	116.8
	17	10	35.2	101.2
9. Waiteariki Stream	26	13	74.2	111.5
	29	20	78.3	117.2
10. Waitawheta River	31	22	25.6	134.2
	29	21	23.5	125.5

Table 3-5:Summary of macroinvertebrate results for the Waihou monitoring sites in 2015. The resultsfrom 2015 are in blue; the results from the 2014 survey are included in black for comparison. MCI scores lessthan 80 are classified as 'poor,' scores 80-100 are 'fair,' scores 100-120 are 'good,' and scores greater than 120are considered 'excellent' (Stark & Maxted 2007).



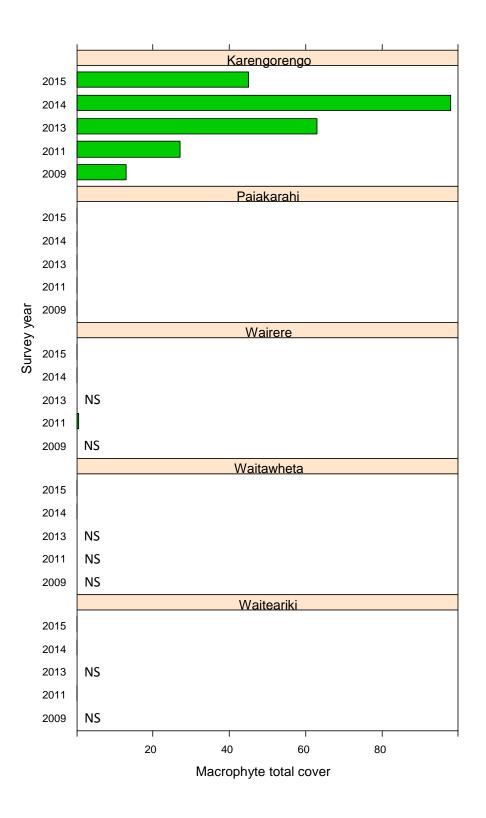


#### 3.2.3 Macrophytes & periphyton

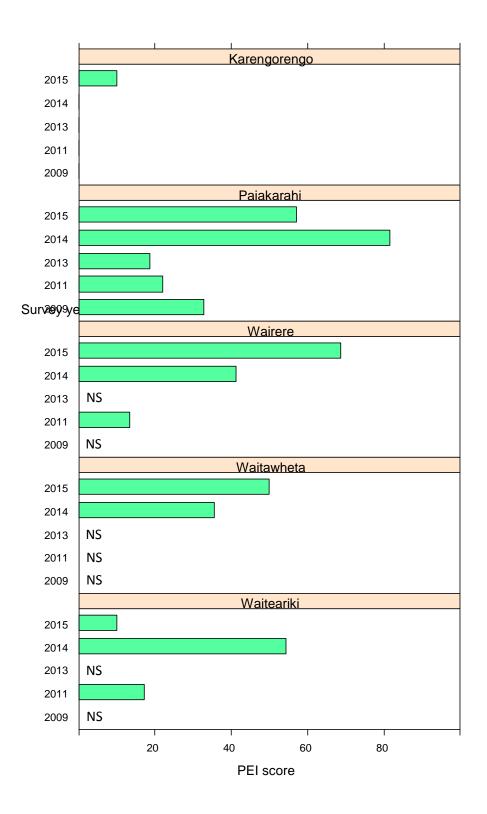
Macrophyte cover is low at all the Waihou survey sites except the Karengorengo Stream (Figure 3-12). At the Karengorengo site, macrophyte cover progressively increased from 2009 to 2014, when the whole channel was clogged with macrophytes (MTC = 98%). However, in 2015 macrophyte cover was reduced approximately 50% (MTC = 45%) from the previous year. This is the lowest macrophyte cover observed since 2011. The emergent species *Apium nodiflorum* remains the dominant macrophyte present in the reach.

Periphyton enrichment scores (PEI) were higher than 2014 in the Wairere and Waitawheta sites and lower in the Paiakarahi and Waiteariki sites. Interestingly, PSI scores were the opposite; the PSI score was higher in the Paiakarahi in 2015 compared to 2014, but lower in the Wairere and Waitawheta. This indicates that there was an increase in long filamentous algae in the Wairere and Waitawheta, and a shift towards greater coverage by thin film algae in the Paiakarahi.

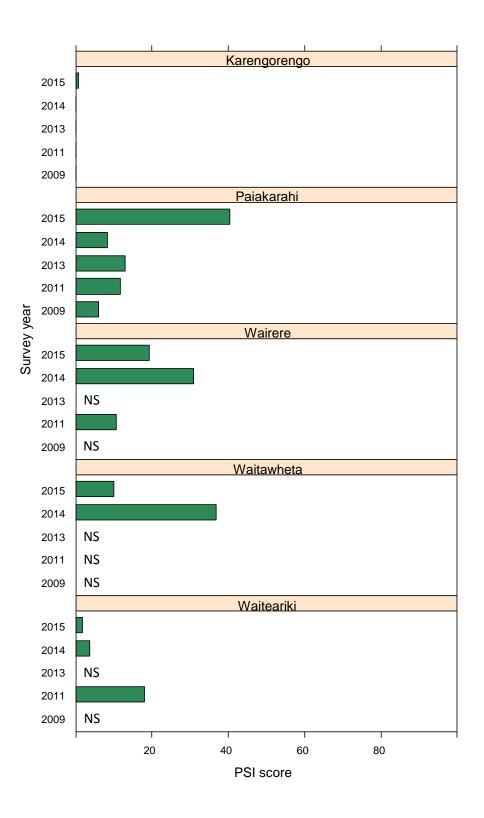
This was also the first year periphyton scores were recorded for the Karengorengo site; prior to 2015 the heavy macrophyte cover at that site shaded out benthic algal growth.



**Figure 3-12:** Comparison of macrophyte total cover (MTC) scores over time at the Waihou survey sites. Years in which a site was not surveyed are marked 'NS.'



**Figure 3-13:** Comparison of periphyton enrichment index (PEI) scores over time at the Waihou survey sites. Years in which a site was not surveyed are marked 'NS.'



**Figure 3-14: Comparison of periphyton sliminess index (PSI) scores over time at the Waihou survey sites.** Years in which a site was not surveyed are marked 'NS.'

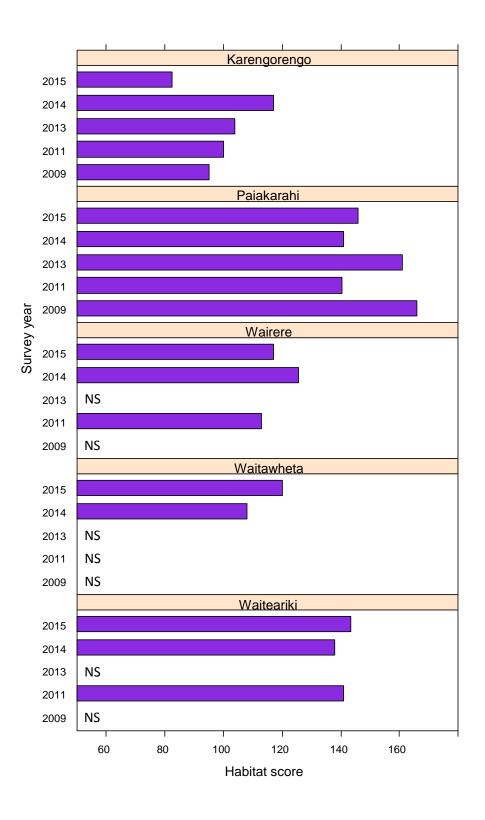
#### 3.2.4 Habitat quality scores

The habitat quality scores have remained relatively stable over time at most of the Waihou survey sites (Figure 3-15). The only site where any significant change occurred between 2014 and 2015 was the Karengorengo Stream, which declined in habitat quality. Prior to 2014 the habitat score at this site was increasing over time due to the exclusion of cattle. However, in 2015 increased stream bank erosion, notably pugging and bank slumping, was observed, resulting in reduced habitat quality. This increase in bank instability was likely associated with a decline in stream bank vegetation. Broadly speaking, the habitat score is greater in the locations where streams are less heavily modified, with a more intact riparian zone.

Correlations between habitat scores and biotic indices again indicated a positive association between the macroinvertebrate indices and habitat quality (n=18; MCI  $\rho$ =0.42; %EPT  $\rho$ =0.67) (Table 3-6 & Figure 3-16). There was also a much stronger correlation between fish species richness and habitat score at the Waihou sites ( $\rho$ =0.69), when compared to the Piako sites (Figure 3-17). This, in part, probably reflects the larger range in fish species richness in the Waihou catchment (maximum 8 species) compared to the Piako (maximum 5 species), and is indicative of a negative impact on fish species richness associated with increased channel modification.

Table 3-6:	Correlation coefficients between the habitat score and various biotic indices for the Waihou
catchment.	

Biotic index	Spearman's rank correlation coefficient
MCI	0.44
Macroinvertebrate total richness	0.42
EPT richness	0.42
% EPT	0.67
Fish richness	0.69



**Figure 3-15:** Comparison of habitat scores over time for the Waihou survey sites. Years in which a site was not surveyed are marked 'NS.'

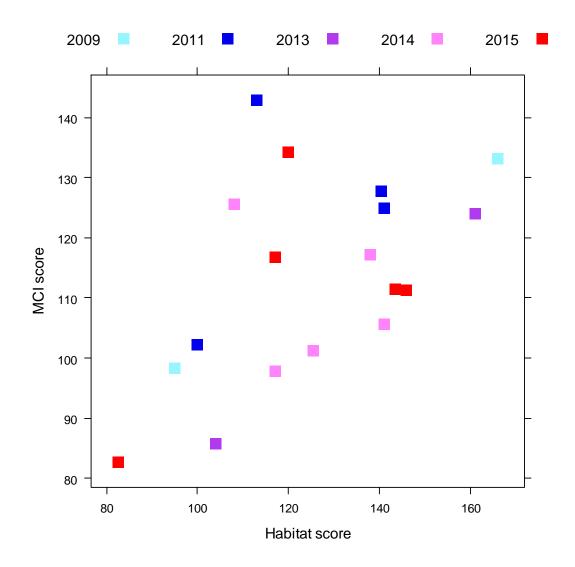


Figure 3-16: Scatterplot of habitat score against MCI score at the Waihou survey sites in different survey years ( $\rho$ =0.44).

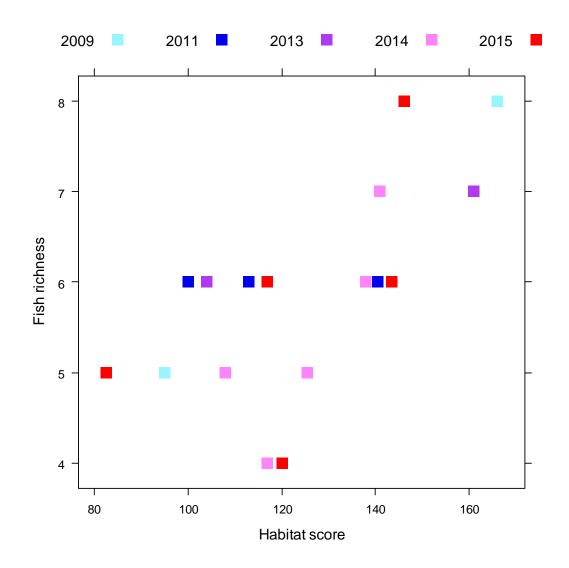


Figure 3-17: Scatterplot of habitat score against fish species richness at the Waihou survey sites in different survey years ( $\rho$ =0.69).

### 4 Discussion

One of the fundamental objectives of setting water resource use limits is the protection of ecosystem health. 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 human induced changes to the environment, e.g., water abstraction, pollutant discharges, land drainage and stream restoration.

Ecological monitoring is essential to understanding ecological status and trends. Franklin et al. (2013) proposed five sites in each of the Waihou and Piako catchments where annual ecological monitoring should take place with the aim of supporting the water allocation decision making process. This recommendation was based on attaining a compromise between spatial coverage of the catchments and characterising natural inter-annual variations in the biotic communities. The ten sites are representative of a range of river types typical of each catchment (i.e., lowland, upland, more modified, less modified, different tributaries), with the aim of providing a broad catchment scale overview of ecological status. These ten sites have now been monitored for two years (2014 and 2015), and all but one (Waitawheta) of the selected sites were also surveyed in either 2009, 2011, or 2013 (or a combination of those years).

#### 4.1 Piako catchment

The results of this survey indicate that at the Piako catchment sites, the relative abundance of fish was generally lower in 2015 than in previous survey years. Inanga continued to be absent from all five sites (compared with being present at two of the sites in 2012). Whilst the sites where they were found in 2012 (Waitoa and Mangapapa) are towards the upper extent of their likely range in the Piako, their absence is possibly indicative of the lower flows in the three successive years and hence reduced downstream connectivity. However, inanga are highly mobile and typically have low encounter probability, and thus may have been present but not captured in recent surveys.

The macroinvertebrate community scores for streams in the Piako catchment remained fairly constant at two sites (Waitakaruru and Piakonui), declined at two sites (Mangapapa and Mangakahika) and improved at one site (Waitoa). Decreased periphyton and macrophyte coverage appear to be associated with improved habitat quality and MCI scores at the Waitoa Stream site. Additionally, the fact that periphyton did not increase substantially in the absence of shading from macrophytes may suggest that eutrophication effects slowed in the Waitoa between 2014 and 2015. Further monitoring in subsequent years will be required to confirm this hypothesis. In the Mangakahika, on the other hand, it is likely that the lower MCI score is related to the decline in habitat quality at that site, which was in turn linked to bank erosion and lack of riparian vegetation, rather than high periphyton and/or macrophyte cover.

#### 4.2 Waihou catchment

In the Waihou catchment, the numbers of fish recorded in 2015 were generally similar to those from previous surveys. A notable exception, however, is banded kokopu, which were found at three sites in 2014, but only one in 2015. However, the numbers of banded kokopu captured in 2014 were low

(one individual only in two of the three sites) and thus it is likely they were missed, rather than absent, from the same sites in 2015. Additionally, the Karengorengo site, which was largely unfishable due to very dense aquatic plant cover in 2014, was much less clogged with macrophytes in 2015 and the recorded fish abundances were similar to those reported from surveys prior to 2014. Importantly, inanga were once again captured from this site, after being absent in 2014.

Macroinvertebrate taxa richness was the highest yet recorded in four of the five Waihou catchment sites in 2015. MCI scores also improved in three of the five Waihou sites in 2015 compared to 2014, although all sites remained in the same quality class. In 2014, three of the four sites dropped a quality class; this year's survey indicates that may have been a temporary change due to low flows or changes in habitat quality, rather than a long-term trend. Interestingly, the Karengorengo score remained low (in the 'fair' category), despite significant declines in macrophyte cover. However, the Karengorengo habitat quality score was also much lower in 2015 than 2014 due to reduced riparian vegetation cover and corresponding increases in stream bank instability.

In both catchments, few juvenile longfin eels were captured, indicating that the recruitment of longfin eels may currently be relatively poor. For shortfin eels, on the other hand, there were very few larger female fish captured, perhaps indicating poor growth/survival rates for this species, or high fishing pressure. The number of inanga and torrentfish captured during surveys in both catchments was also lower in most sites in 2015 than in 2014. Torrentfish have very specific habitat requirements, preferring fast flowing, turbulent habitats, and thus tend to be constrained to relatively small habitat patches within the survey reaches. Small changes in habitat structure between years can result in the loss of these habitats. These habitats are also probably more susceptible to the effects of low flows. This is likely to contribute to the observed variance in torrentfish populations which may move out of reaches during low flows in search of suitable habitats. Inanga have also generally only been found in very low numbers at the sites included in this survey; this could be due to a lack of suitable habitat or more likely distance from the coast.

## 5 Conclusions

Ecosystem health has been identified as a core national value that must be sustained (MfE 2013). The NPSFM requires that regional councils set freshwater objectives and associated limits to water resource use that will ensure those objectives are met (MfE 2014). Reliable information on the status and temporal dynamics of instream ecosystems is therefore critical to both setting appropriate protection levels and ensuring that freshwater objectives are met.

Knowledge of natural dynamics and variability in New Zealand's freshwater ecological communities is relatively limited, particularly for fish. 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 results of this survey help to support the water allocation decision making process by informing WRC on the status and trends in ecological communities of the Waihou and Piako. The reported inter-annual variation between even subsequent yearly samplings highlights the need for long-term monitoring to accurately characterize natural variation versus long-term trends in stream communities and stream health. Therefore, it is recommended that the same ten sites continue to be monitored annually using the same survey methods. This will help to build understanding of the natural variability in the ecological communities of these sites and to identify critical interactions and drivers of community stability and/or change. In addition to the annual monitoring sites, it may be valuable to monitor a further group of sites at less frequent intervals (i.e., every 3-5 years) to improve the spatial coverage of the monitoring. Some sites may already be included in the standard WRC REMS monitoring programme and it may be beneficial to include reference to these data as they are collected. 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 (particularly their associations with flow). The establishment of this ecological monitoring programme in the Waihou and Piako catchments is a first step to understanding the ecological communities and dynamics that exist and therefore in setting appropriate protection levels. Evidence from these surveys already demonstrates the differences in structure and functioning of the ecological communities at different sites and particularly a difference is emerging between more and less heavily modified sites e.g., Piakonui versus Waitoa in the Piako catchment, and Paiakarahi versus Karengorengo in the Waihou catchment. This will support WRC in identifying appropriate freshwater objectives and setting related ecosystem protection levels in these catchments.

### 6 Recommendations

- It is recommended that annual ecological monitoring continues at these ten sites. This will help to determine and understand the temporal dynamics of ecological communities, providing a more robust baseline against which to monitor the effects of human impacts on these river ecosystems over time. The relative balance of the assemblage, particularly for the most numerically dominant species, should also be evaluated in future surveys to help assess changes in community composition over time.
- It would be beneficial for additional physico-chemical variables to also be collected at each of the sites, e.g., flow, water temperature and water quality. This would allow evaluation of the relative importance of different environmental variables in determining the observed variations in ecology. Where possible, this should include regular sampling (preferably continuous), rather than one-off spot samples.
- To improve the spatial coverage of the monitoring, it may be valuable to introduce a further group of sites for monitoring once every 3-5 years.
- It would be beneficial to collate historical ecological monitoring data (e.g., REMS) collected by WRC in the catchments to supplement the analyses undertaken as part of this programme.

### 7 Acknowledgements

The assistance of Mike Martin and Bastiaan van Ravenhorst in completing the fieldwork was greatly appreciated.

#### 8 References

- Boothroyd, I., Stark, J.D. (2000) Use of invertebrates in monitoring. In: K. Collier & M.J. Winterbourn (Eds). New Zealand stream invertebrates: ecology and implications for management. New Zealand Limnological Society, Christchurch: 344-373.
- Collier, K., Kelly, J. (2005) Regional guidelines for ecological assessments of freshwater environments: Macroinvertebrate sampling in wadeable streams. *Environment Waikato Technical Report*, 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*, 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*, 2010/09: 31.
- Franklin, P.A., Bartels, B. (2012) Piako catchment ecological monitoring 2012. *NIWA Client Report*, HAM2012-070: 94.
- Franklin, P.A., Booker, D.J. (2009) Flow regime requirements for instream ecology in the Waihou River catchment. *NIWA Client Report*, HAM2009-089: 176.
- Franklin, P.A., Croker, G., Julian, K., Smith, J., Bartels, B. (2011) Waihou catchment ecological monitoring 2011. *NIWA Client Report*, HAM2011-036: 91.
- Franklin, P.A., Croker, G., Wharakura, R., Reeve, K., Smith, J. (2014) Waihou and Piako ecological monitoring 2014. *NIWA Client Report*, HAM2014-044: 106.
- Franklin, P.A., Smith, J., Croker, G. (2013) Waihou and Piako ecological monitoring 2013. *NIWA Client Report*, HAM2013-045: 91.
- MfE (2011) National Policy Statement for Freshwater Management 2011: 12.
- MfE (2013) Proposed amendments to the National Policy Statement for Freshwater Management 2011: A discussion document: 79.
- MfE (2014) National Policy Statement for Freshwater Management 2014: 34.
- Stark, J.D., Boothroyd, I., Harding, J., Maxted, J.R., Scarsbrook, M.R. (2001) Protocols for sampling macroinvertebrates in wadeable streams. *New Zealand Macroinvertebrate Working Group Report*, 1: 57.
- Stark, J.D., Maxted, J.R. (2007) A user guide for the Macroinvertebrate Community Index. *Cawthron Report*, 1166: 58.
- Waikato Regional Council (2012) Waikato Regional Plan. *Environment Waikato Policy Series*, 2007/21.

# Appendix A Habitat assessment forms

Stream name: Manga	kahika Strean	n			Assesso	r: Josh	Smith			
Site number: 376_4		Samp	le number: 1		Date: 2,	/03/20	15	Time	14:30	
GPS coordinates		Down	stream:		E 18186	598		N 583	88814	
		Upstr	eam:		E 18186	518		N 583	8767	
Channel & riparian	features				Instrea	m hy	draulic co	ondit	ions	
Canopy cover:					Estimate	d or me	asured read	ch ave	rage:	
Open	Partly s	haded	Verys	shaded						
Fencing:	Dominant	ripariar	n vegetation:		Stream	width	(active cha	annel)	: 4.5 m	
None/ineffective	Crops		Retired ve	getation	Stream	width	(water): 2.	0 m		
One side/partial	Pasture		Native shr	ub	Stream	depth:	0.15 m			
Complete	Exotic tree	S	Native tree	es	Surface	veloci	ty: 0.20 m	S⁻¹		
Water quality					-					
Temperature:	17.5		°C		Conduc	tivity:		197.8	μ	S cm <sup>-1</sup>
Dissolved oxygen:	70.3		%		6.72			mg l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ned	(	Other	
Stream-bottom sub	c substrata):				compos	ition:	rganic sub		I	
Assorted sizes tightly	packed &/or	overlap	ping		Substra	tum	Dimensi	on	Percer	ntage
Moderately packed w			-		Bedrocl		-		5	
Mostly a loose assortr					Boulder		>256mm		5	
No packing/loose asso	ortment easily	y move	d		Cobble		>64-256mr	n	75	
Embeddedness:					Gravel		>2-64mm		10	
(% gravel-boulder particle	i .		I I	. 750/	Sand		>0.06-2mm		3	
<5% 5-25	26-5	50%	51-75%	>75%	Silt		<0.004=0.00		2	
Organia motorial /9	(				Clay	• • • • • • •				
Organic material (% Large wood (>10cm d	-				(% of eff		s sample	a		
<5% 5-25°	, í	50%	51-75%	>75%	Stones:	UI CJ	50%			
Coarse detritus (small	1		I I	21570	Wood:		%		fles:	20 %
<5% 5-25	i i		51-75%	>75%	Macrop	hvte:	%		ns:	70%
Fine (<1mm) organic o	I				Edges:	.,	50%	-	ols:	10%
<5% 5-25	· .	50%	51-75%	>75%	0	r of inv	ertebrates			
Instream plant cov			ia)		Koura:		1		ips: 0	
Filamentous algae & r			,		Crabs: (	)		Muss	els: 0	
< <b>5%</b> 5-25	1	50%	51-75%	>75%	Other: (				-	
Macrophytes:	I		i I		Mussel					
	% 26-5	50%	51-75%	>75%						
< <b>5%</b> 5-25	I.		ı İ							
<5% 5-25 Mosses/liverworts:										
I	% 26-5	50%	51-75%	>75%						

Stream name: Manga	kahik	а						5	ite n	umb	er: 3	764								
Sample number: 1	-	-		A	ssess	or: Jo	osh S					_	Date	: 2/0	3/20	15				
										Cate	gory									
Habitat parameter		С	ptim	al			Sub	optii	nal			Μ	argin	al				Poor		
1. Riparian vegetative zone width	•	>10n	tation า inuou	buffe s &	er	•	Banks veget <10m Most	tation			•	Pathy and/o Most	or sto	ck		•		ks frei ian ac ous		
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																				
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian y n orey	•	nativ Disru Bank	red m e vege ption s may red by	ainly etatio evide be	n ent	•	Bank cover of gra black & intr specie Veget disrup Bare cropp comm	red by asses/ berry, roduc es tation ation soil/cl wed ve	y mixt /shrub , willo ed obvio losely	us	•	cove & sh Disru strea vege high Gras graz Signi	uption am ba tatior s heav	y gras: of nk very vily	Ĩ
Left bank: 9	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: 9																				
3. Bank stability	•	Erosi failur abse	nt/mi of bar	ink nimal		•	Infred areas	of er ly hea 6 of b	, sma osion led o	II	• • •	Mode unsta 30-60 reach erosid High poter flood	ble % of has a on erosic ntial d	, bank areas on	of	• • •	60-1	able y eroc 00% c erosio	of ban	k
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	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee led by lth=5- habita	en / -7	•	Dista riffles	s infre	quen etwee led by	en /	• • •	Occas run Botto provie habita Distai riffles streat 25	im coi de soi at nce bi i divid	ntour me etwee led by	s en	• • •	wate riffle Poor Dista riffle	erally er, sha s habit ance b s divio am wio	llow at etwee ded by	/
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	•	chan abse Strea		redgir nimal :h	0	•	Evide chani Recei chani	nel/dr nce o nel/dr	edgir f past edgir	ng : ng	•	Chang chang exten Emba ing st prese banks 40-80	ges/di isive inkme ructu int on 5 0% of	ents/s res both reach	hor	•	gabi >80% reac or di Instr	ks shot on/ce % of st h char srupte ream h red/ab	ment ream nnelize ed nabita	ed
												chanı disru		uα						

Habitat parameter			atego ptim			Ha	bitat	para	mete	r			itego ptim			На	bitat	para	mete	er
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted by		nt	•	form from or fin 20-50 affec	t depo	most el, san iment botto	ly d t m	•	Some new { fine s old & 50-80 affect Sedin at ob const bend	gravel edime new 0% of ted nent of struct rictio	l, sand ent of bars botto depos cions,	dor า m	•	fine i Incre deve >80% chan frequ Pools abse sedir	mater ased lopm 6 of b ging uently s almont due	bar ent ottom ost e to	
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> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					regin If fas	tity/de nes pr t/shal ng the	esent low is		•	2 of 4 veloc regim If fast slow/ missi	ity/de ies pr :/shal /shallo	esent low o ow ar	r e	•	veloo regin	city/d ne	d by 1 epth ep/slo	
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	•	favou inver color varie debri mats Snags logs/ banks provi fish c	irable tebra isatio ty of v s, riff s/ sub under s/cob des a over not b	e for te on & v wood les, ro omerg rcut	y oot ed	•	favou inver color Snag logs/ bank Fish o Mode of ha Can o	0% su urable tebra hisatic s/ sub under s/cob cover erate bitat consis mater	for te on cut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra isatio over 0% sul y mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favor inver color Fish abse Subs or lac Stabl lackin	urable tebra nisatio cover nt trate cking e hat	ite on rare o unsta bitats limite	ble
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	held Stabl	ent on stone e sub ces ro	hand	!	•	visibl Stabl	hytor e on s e sub hytor uch	stones strate		• •	Perip <20% availa	cove	r of		•	& pro	olific 6 cove	n obvi er of substr	
Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 110																				

Stream name: Waitoa	Stream				Assesso	r: Josh	Smith			
Site number: 1249_12	21	Samp	ole number: 2		Date: 5,	/03/20	15 T	ïme: 1	3:00	
GPS coordinates		Dow	nstream:		E 18319	74	١	1 5803	819	
		Upst	ream:		E 18318	78	Ν	1 5803	808	
Channel & riparian	features				Instrea	m hy	draulic co	nditio	ns	
Canopy cover:					Estimate	d or me	asured reach	n avera	ge:	
Open	Partly s	haded	Very sl	haded						
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cha	nnel):	4.5 m	
None/ineffective	Crops		Retired veg	etation	Stream	width	(water): 1.4	l m		
One side/partial	Pasture		Native shru	b	Stream	depth:	0.15 m			
Complete	Exotic tree	S	Native tree	S	Surface	velocit	y: 0.15 m s	-1		
Water quality	•				-					
Temperature:	16.7		°C		Conduc	tivity:	1	19.9	μ	S cm <sup>-1</sup>
Dissolved oxygen:	69.2		%		6.76		r	ng l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ied	Ot	her	
Stream-bottom sul	ostrata		.1							
Compaction (inorgan					% surfic		rganic subs	tratur	n size	
Assorted sizes tightly	packed &/or	overla	oping		Substra		Dimensio	n	Percen	itage
Moderately packed v		-			Bedrock		-			8-
Mostly a loose assort			-		Boulder		>256mm		5	
No packing/loose asso					Cobble		>64-256mm		70	
Embeddedness:		,			Gravel		>2-64mm		10	
(% gravel-boulder particl	es covered by f	ine sedi	iment)		Sand		>0.06-2mm		5	
<5% 5-25	1		51-75%	>75%	Silt		0.004-0.06m	ım	5	
			1 1		Clay		<0.004mm		5	
Organic material (9	6 cover)					t type	s sampled	1		
Large wood (>10cm d	-				(% of eff		p	•		
<5% 5-25	1	50%	51-75%	>75%	Stones:		%			
Coarse detritus (small	I		1 1		Wood:		%	Riff	es:	209
< <b>5%</b> 5-25	Í		51-75%	>75%	Macrop	hvte:	%	Run		755
Fine (<1mm) organic	I		1 1		Edges:	,	%	Роо		5
< <b>5%</b> 5-25	· 1	50%	51-75%	>75%		r of inv	ertebrates			
Instream plant cov					Koura: :		I	hrimp		
Filamentous algae & I			1		Crabs: 0			/ussel		
<5% 5-25		50%	51-75%	>75%	Other: (					
	1 20				Mussel					
I	% 26-5	50%	51-75%	>75%	Hyridell		6	Cucum	erunio	
Macrophytes: <5% 5-25			1 1		,					
Macrophytes:					1					
Macrophytes: <b>&lt;5%</b> 5-25	% 26-5	50%	51-75%	>75%						

Wadeable Hard-Bo Qualitative Habitat As					Shee	et														
Stream name: Waitoa	Strea	am						9	Site n	umb	er: 12	249_:	121							
Sample number: 2				А	ssess	or: Jo	osh S	mith					Date	: 5/0	3/20	15				
Habitat parameter	÷	C	ptim	al			Sub	oopti	mal	Cate	gory		argir	nal				Poor		
1. Riparian vegetative zone width	•	>10n	tatior n inuou	n buffe is &	er	•	<10m	tation			•	Pathy and/o Most	or sto	ck		•		ks fre ian ac ous		
Left bank:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Right bank:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 6																				
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove re veg s, und bs or r dy pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	of gra black & int speci Vege disru Bare	red by asses/ berry roduc es tatior ption soil/c ped ve	y mixt /shrut y, willo ed n obvio	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	s heav	y gras: of nk very vily	ζ.
Left bank:4	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: 4																				
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infree areas most	eratel quent s of er ly hea % of b ed	, sma osion iled o	II	•	unsta 30-60 reach erosi High	0% of n has a on erosio ntial c	bank areas	of	•	60-1	able y eroc 00% c erosio	of ban	k
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																				
4. Frequency of riffles	•	frequ Dista riffle strea	uent ince b s divio im wio	tively etwee ded by dth=5 habita	en / -7	•	riffles Dista riffles	rrenco s infre nce b s divic m wic	equen etwee led by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic	me	s en /	•	wate riffle Poor Dista riffle	erally er, sha s habit ance b s divio am wio	llow at etwee ded by	Ý
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th	ng	•	chan Evide chan Recei chan	e char nel/di ence o nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme tructu ent on s 0% of nelize	res both reach	hor	•	gabi >809 reac or di Instr	ks sho on/ce % of st h char srupte ream h red/ab	ment ream nnelize ed nabita	ed
Score:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter			atego ptim			На	bitat	para	mete	r			atego ptim			На	bitat	para	mete	r
6. Sediment deposition	•	point <20% affect sedin	/no is bars of bo ted by nent sition	prese ottom /	nt	•	form from	ted t depo	most I, san iment botto	ly d t m	•	Some new; fine s old & 50-80 affec Sedin at ob const bend	gravel edim new 0% of ted nent o struct	l, sand ent or bars botto depos :ions,	dor า m	• • •	fine Incre deve >80% chan frequ Pool abse sedir	mater ased lopm 6 of b	bar ent ottom ost e to	
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Velocity/depth regimes	•	regin Slow/ slow/	ocity/ nes pr /deep /shallo shallo deep	esent , ow,		•	regin If fas	ity/de nes pr t/shal ng the	esent low is		•	2 of 4 veloc regin If fas slow/ missi	ity/de nes pr t/shal (shallo	esent low o ow are	r e	•	velo regir	city/d ne	d by 1 epth ep/sk	
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	•	favou inver colon variet debri mats Snags logs/t banks provi fish c	not b	for te woody les, ro merg cut bles bunda	y oot ed ant	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	0% sul irable tebra iisatio s/ sub under s/cob cover erate bitat consis mater	for te merg cut bles comn variet types t of so	ed non y	•	10-30 favou inver color Fish c 60-90 easily foot Wood or ma smot sedin	tebra nisatio cover 0% sul 7 mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favo inver color Fish abse Subs or la Stab lacki	nt trate cking le hat	e for te on rare o unsta itats limite	ble
Score: 13	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held s Stabl	hytor ent on stone e sube ces ro	hand s strate		•	visibl Stabl	hytor e on s e sub: hytor uch	tones strate		•	Perip <20% availa	'	r of		•	& pr >20%	, olific 6 cove	n obvi er of ubstra	
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 100																				

Stream name: Manga	papa Stream				Assesso	r: Josh	Smith			
Site number: 433_14		Samp	ole number: 3		Date: 5/	′03/20	15 1	ime: 9:30	)	
GPS coordinates		Dowi	nstream:		E 18367	83	1	N 5809932	2	
		Upsti	ream:		E 18367	50	ı	N 5809802	2	
Channel & riparian	features				Instrea	m hyo	draulic co	nditions		
Canopy cover:					Estimate	d or me	asured reac	n average:		
Open	Partly s	haded	Very s	haded						
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cha	nnel): 5.5	m	
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 3.8	3 m		
One side/partial	Pasture		Native shru	ıb	Stream	depth:	0.15 m			
Complete	Exotic tree	S	Native tree	S	Surface	velocit	y: 0.20 m s	5-1		
Water quality										
Temperature:	16.1		°C		Conduc	tivity:	1	16.7	μS	cm-1
Dissolved oxygen:	55.8		%		5.51		r	ng l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ed	Othe	r	
Stream-bottom sub	ostrata									
Compaction (inorgan	ic substrata):				% surfic		rganic sub	stratum s	ize	
Assorted sizes tightly	packed &/o	overla	apping		Substra		Dimensio	on Per	rcent	tage
Moderately packed w	-				Bedrock		-	95		-
Mostly a loose assort			-		Boulder		>256mm			
No packing/loose asso					Cobble		>64-256mm	1		
Embeddedness:		-			Gravel		>2-64mm			
(% gravel-boulder particl	es covered by f	ine sedi	ment)		Sand		>0.06-2mm	3		
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Silt		0.004-0.06r	<sup>nm</sup> 2		
I	I		1 1		Clay		<0.004mm			
Organic material (%	6 cover)				Habita	t type	s sample	ł		
Large wood (>10cm d					(% of effe					
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Stones:		%			
Coarse detritus (small	wood, sticks	, leave	s etc., >1mm)		Wood:		%	Riffles:		15
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Macrop	hyte:	5%	Runs:		80
Fine (<1mm) organic	deposits				Edges:		95%	Pools:		5
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Numbe	r of inv	ertebrates	returned	:	
Instream plant cov	er (% stream	bed are	ea)		Koura: 1	1	9	Shrimps: C	)	
Filamentous algae & r	•		•		Crabs: C	)	1	Aussels: 2	! live	
<5% 5-25	1	50%	51-75%	>75%	Other: 0			+ mar		
Macrophytes:	I		ı I		Mussel				•	
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Hyridell		0	Cucumeru	nio	
ا Mosses/liverworts:	I		i I							
1	% 26-'	50%	51-75%	>75%						
<5% 5-25							1			

Stream name: Manga	papa	Strea	m					(	Site n	umb	er: 4	33 14	1							
Sample number: 3	papa			А	ssess	or: Jo	osh S					<u> </u>		: 5/0	3/20	15				
								-		Cate	gory			-,-	-, -	-				
Habitat parameter		С	ptim	al			Sub	oopti	mal		0,		argir	ial				Poor		
1. Riparian vegetative zone width	•	>10n	tatior n inuou	ı buffe s &	er	•	Bank veget <10m Most	tation า			•	Pathy and/o Most	or sto	ck		•		ks fre Ian ac Ous		
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:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 9.5			•	<u> </u>													<u> </u>	<u> </u>		
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und os or i dy pla ent tative	nts	ian y n orey	•	nativ Disru Bank	red m e veg ption s may red by	ainly etatio evide be	n ent	•	Bank cover of gra black & intr speci Vege disru Bare cropp comr	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrub , willo ed obvio losely	us	•	cove & sh Disru strea vege high Gras graz Signi	s hea	y gras of nk very vily	:
Left bank:9	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: 8																				
3. Bank stability	•	Erosi failur abse	nt/mi of bai	ank nimal		•	Infree areas	of er ly hea % of b	, sma osion iled o	II	•	Mode unsta 30-60 reach erosid High poter flood	ible )% of i has a on erosic ntial d	bank areas	of	•	60-1	able y eroc 00% c erosio	of ban	k
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:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12.5																				
4. Frequency of riffles	•	frequ Dista riffle strea	ient nce b s divio m wie	tively etwee led by dth=5- habita	en / -7	•	Dista riffles	s infre	equen etwee led by	en /	•	Occas run Botto provi habit Dista riffles strea 25	om co de so at nce b s divic	ntour me etwee led by	s en	•	wate riffle Poor Dista riffle	erally er, sha s habit ance b s divio am wi	llow at etwe ded by	/
Score:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	chan abse Strea		redgir nimal th	ng	•	chan Evide chan Recei chan	nel/dı	redgir of past redgir redgir	ng : ng	•	Chan chang exter Emba ing st prese banks 40-80 chan	ges/d nsive nkme ructu ent on s 0% of	ents/s res both reach	hor	•	gabi >80% reac or di Instr	ks sho on/ce % of st h chai srupto ream h red/at	ment ream nneliz ed nabita	ed

Habitat parameter		Categ Optir			Ha	abita	t para	amet	er			atego ptim			Ha	bitat	para	imete	er
6. Sediment deposition	ро • <2 а1	ttle/no is oint bars 20% of b ffected b epositior	prese ottom y sedi	ent 1	•	bar mos grav fine 20-5 affe Sligl	forma stly fro vel, sa sedir 50% o cted	nd or	om	• • •	Some new ( fine s old & 50-80 affec Sedin at ob const bend	grave edim new 0% of ted nent o struct	l, sand ent of bars botto depos tions,	dor า m	•	fine Incre deve >809 char freq Pool abse sedi	mate eased elopm	bar ent ottom / ost e to	
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	• SI sl	velocity, egimes p low/deep ow/shall ast/shallo ast/deep	resent o, ow,		•	regi If fa miss	ocity/o mes p		nt	• •	If fas	ity/de nes pr t/shal (shallo	esent	r e	•	velo regii	city/c me	d by 1 epth eep/slo	
Score: 16	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	fa in cc va dd m Si lo ba ba fit	50% subs avourable vertebra clonisatic ariety of ebris, riff nats nags/ sul gs/unde anks/cob rovides a sh cover lust not l ansient	e for ite on & v wood iles, ro omerg rcut ibles ibund	y oot ged ant	•	favo inve colo Snay logs ban Fish com Moo of h Can som	ourablertebr onisati gs/ su /unde ks/co cove mon derate	ate ion bmer ercut bbles r e varie t type ist of	ged	•	10-30 favou inver color Fish c 60-90 easily foot Wood or ma smot sedin	urable tebra iisatic cover 0% su 7 mov dy de ay be herec	for te patch bstrat ed by bris ra	y e	•	favo inve colo Fish abse Subs or la Stab lacki	urabl rtebra nisati cover ent strate icking le hal	ate on rare o unsta bitats limite	ble
Score: 11	20	19 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	ev st • St • St	eriphyto vident or cones table sub urfaces r ouch	n hanc strate	2	•	visik Stak Peri	ole on ole su phyto	on not stone bstrat on o toue	es e	•	<20%	cove	n visib r of ubstra		•	& pr >209	olific % cov	n obvi er of substr	
Score: 8	20 1	19 18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 116											•			•	•				

Stream name: Waitaka	ruru Stroom				Assesso	r. loch	Smith			
Site number: 1231_54	Turu Stream		le number: 4		Date: 2			Timo	: 10:45	
GPS coordinates			istream:		E 18177		15	-	15748	
GPS coordinates					E 18179				15748	
Channel 8 mineries (		Upstr	edili.		1		م المعالم			
Channel & riparian f	eatures					-	draulic c			
Canopy cover:	Devil		Maria	- la - da - d	Estimate	a or me	asured rea	cn ave	erage:	
Open	Partly s		-	shaded			(		10	
Fencing:		ripariar	vegetation:				(active ch		): 4.0 m	
None/ineffective	Crops			egetation			(water): 2	.0 m		
One side/partial	Pasture		Native sh		Stream	•				
Complete	Exotic tree	S	Native tre	ees	Surface	veloci	ty: 0.50 m	I S <sup>-1</sup>		
Water quality										
Temperature:	17.6		°C		Conduc	tivity:		136.3		S cm <sup>-1</sup>
Dissolved oxygen:	86.6		%		8.30	1		mg l <sup>-</sup>	1	
Turbidity:	Clear		Slightly turbio	d Highly	turbid	Stair	ied		Other	
Stream-bottom sub	strata									
Compaction (inorganio	: substrata):				% surfic compos		rganic su	bstrat	um size	
Assorted sizes tightly p	acked &/or	overlap	ping		Substra	tum	Dimens	ion	Percer	itage
Moderately packed wit	h some ove	rlappin	g		Bedrocl	<b>k</b>	-			
Mostly a loose assort	nent with lit	tle ove	rlap		Boulder		>256mm		5	
No packing/loose assor	tment easily	/ move	d		Cobble		>64-256m	im	20	
Embeddedness:					Gravel		>2-64mm		50	
(% gravel-boulder particle	s covered by f	ine sediı	ment)		Sand		>0.06-2m	m	15	
<5% 5-25%	26-5	50%	51-75%	>75%	Silt		0.004-0.0	5mm	10	
	•				Clay		<0.004mn	n		
Organic material (%	cover)				Habita	t type	s sample	ed		
Large wood (>10cm dia	ameter)				(% of eff	ort)				
<b>&lt;5%</b> 5-25%	26-5	50%	51-75%	>75%	Stones:		209	6		
Coarse detritus (small	wood, sticks	leaves	etc., >1mm)		Wood:		Q	% Ri	ffles:	20%
<5% <b>5-25%</b>	26-5	50%	51-75%	>75%	Macrop	hyte:	30%	% Rı	uns:	70%
Fine (<1mm) organic d	eposits				Edges:		50%	% Po	ools:	10%
<5% 5-25%	26-5	50%	51-75%	>75%	Numbe	r of inv	ertebrate	s retu	irned:	
Instream plant cove	r (% stream	bed are	a)		Koura: :	14		Shrin	nps: 0	
Filamentous algae & m					Crabs: (	)		Muss	sels: 0	
<5% 5-25%	1	50%	51-75%	>75%	Other: (					
	I		I I		Mussel	type:				
Macrophytes:								Cucu		
Macrophytes: <5% 5-25%	26-5	50%	51-75%	>75%	Hyridell	a		cucu	merunio	
1	26-5	50%	51-75%	>75%	Hyridell	a		Cucu	merunio	

	5565511	nen	l Field	Data	She	et														
Stream name: Waital	karuru	Str	eam					9	Site n	umb	er: 1	231_!	54							
Sample number: 4				А	ssess	sor: J	osh S	mith					Date	: 2/0	3/20	15				
										Cate	gory									
Habitat parameter		(	Optim	al			Sub	oopti	mal			Μ	argin	al				Рос	or	
1. Riparian vegetative zone width		buff	kside v er >10 tinuou	m		•	<10m	tation			•	and/o	ways p or sto ly hea	ck		•		an a	equent ctivity	
Left bank:9	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: 9																				
2. Vegetative protection	•	imm zone nativ Tree shru woo pres Vege	k surfa ediate es cove ve veg es, und bs or r dy pla ent etative uption	ripari ered b etation er-sto non- nts	y n rey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	cover of gra black & int speci Vege disru Bare	tation ption soil/c ped ve	y mixt /shrut , willo ed obvio losely	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	red k rubs uptio im ba tatio s hea ed fican	ank n very	, K
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	•	Eros abse <5%	ks stab ion/ba ent/mi of bar cted	ınk fai nimal	lure	•	Infre areas most	eratel quent s of er ly hea % of b ed	, sma osion lled o	II	•	unsta 30-60 reach erosi High	0% of has a on erosic ntial d	bank areas on	of	•	60-1	y ero 00%	oded an of ban onal sc	ık
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:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 11							<u> </u>					<u> </u>					<u> </u>			
4. Frequency of riffles	•	freq Dista riffle strea	es rela uent ance b es divic am wic ety of	etwee led by lth=5-	7	•	riffle: Dista riffle:	rrence s infre nce b s divic m wic	quen etwee led by	en /	•	run Botto provi habit Dista riffles		ntour me etwee led by	s en /	•	riffle Poor Dista riffle	r, sh s habi ince s div	allow	y
Score: 7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration		char abse	nges to nnel/di ent/mi am wit ern	redgin nimal	-	•	chan Evide chan Rece chan	e char nel/di ence c nel/di nt nel/di oresen	edgir f past edgir edgir	ng : ng	•	exter Emba ing st prese bank 40-80 Chan	ges/di nsive ankme ructu ent on s 0% of nelize	ents/s res both reach	hor	•	gabio >809 react or di Instr	on/ce 6 of s h cha srupt eam	ored w ement stream anneliz ted habita bsent	ed
	<u> </u>			1	1		-					disru					1			Т
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter		Ca	atego	ory		На	bitat	para	mete	r		Ca	itego	ry		На	bitat	para	mete	r
Habitat parameter		0	ptim	al								0	ptim	al						
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted by		nt	•	form from or fin 20-50 affec	ation, grave e sed 0% of ted t depo	ase in most l, san liment botto ositior	ly d t m	•	Some new § fine s old & 50-80 affect Sedin at ob const bend	gravel edime new 0% of ted nent o struct rictio	l, sand ent or bars botto depos :ions,	d or n m	•	fine r Incre deve >80% chan; frequ Pools abset sedin	mater ased lopme of bo ging lently almo nt due	bar ent ottom ost e to	
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	•		nes pr /deep /shallo shallo	ow,		•	regin If fas	ity/denes pr t/shal	epth esent llow is en sco		•	2 of 4 veloc regim If fast slow/ missi	ity/de ies pr :/shal /shallo	esent low o ow are	r e	•	veloc regin	ity/de ne	l by 1 epth ep/slo	w
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	•	varie debri mats Snag logs/ bank provi fish c	irable tebra iisatic ty of v s, riff under s/cob des a over not b	for te on & w woody les, ro omerg cut	ed ant	•	favou inver color Snags logs/ banks Fish o Mode of ha Can o	urable tebra iisatic s/ sub under s/cob s/cob cover erate bitat	te omerg rcut bles comn variet types t of so	ed non sy	•	10-30 favou invert colon Fish c 60-90 easily foot Wood or ma smot sedim	irable tebra isatio cover 0% sul y mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favou inver color Fish o abset Subst or lao Stabl lackin	nt trate tking e hab	for te n rare c unstal itats limite	ole
Score: 9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held (mac	subst rophy l etc.,	hand rates		•		e on rates		n	•	Perip <20% availa	cove	r of		•	& pro	olific cove	n obvi er of ubstra	
Score: 5	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 87																				

Stream name: Piakonu	ui Stream				Assesso	r: Josh	Smith			
Site number: 753_15		Samp	le number: 5		Date: 4/	03/20	15	Time	: 15:30	
GPS coordinates		Down	stream:		E 18312	11		N 58	15768	
		Upstr	eam:		E 18312	10		N 58	09980	
Channel & riparian	features				Instrea	m hyo	draulic co	ondit	tions	
Canopy cover:					Estimate	d or me	asured rea	ch ave	erage:	
Open	Partly s	haded	Very s	haded						
Fencing:	Dominant	ripariar	n vegetation:		Stream	width	(active ch	annel	l): 3.5 m	
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 2	.0 m		
One side/partial	Pasture		Native shru	du	Stream	depth:	0.15 m			
Complete	Exotic tree	S	Native tree	es	Surface	velocit	y: 0.20 m	S <sup>-1</sup>		
Water quality										
Temperature:	13.1		°C		Conduct	tivity:		90.1	μ	S cm⁻¹
Dissolved oxygen:	82.7		%		8.69			mg l	1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stain	ed		Other	
Stream-bottom sub	strata									
Compaction (inorgani	c substrata):				% surfic		rganic sul	ostrat	tum size	
Assorted sizes tightly	packed &/or	overla	pping		Substra	tum	Dimens	ion	Percen	tage
Moderately packed wi	ith some over	rlappin	g		Bedrock	:	-			-
Mostly a loose assort	nent with litt	le over	lap		Boulder		>256mm		5	
No packing/loose asso	ortment easily	y move	d						60	
					Cobble		>64-256m	m	60	
Embeddedness:		-	-		Gravel		>64-256m >2-64mm	m	10	
Embeddedness: (% gravel-boulder particle	es covered by f	ine sediı								
	1			>75%	Gravel		>2-64mm	n	10	
(% gravel-boulder particle	1		ment)	>75%	Gravel Sand		>2-64mm >0.06-2mr	n imm	10 15	
(% gravel-boulder particle <5% 5-259	% 26-5		ment)	>75%	Gravel Sand Silt Clay	t type	>2-64mm >0.06-2mr 0.004-0.06	n imm	10 15	
(% gravel-boulder particle <5% 5-259 Organic material (%	% 26-5 6 cover)		ment)	>75%	Gravel Sand Silt Clay		>2-64mm >0.06-2mr 0.004-0.06 <0.004mm	n imm	10 15	
(% gravel-boulder particle <5% 5-259 Organic material (%	% 26-5	50%	ment)	>75%	Gravel Sand Silt Clay <b>Habita</b>		>2-64mm >0.06-2mr 0.004-0.06 <0.004mm	n imm i e <b>d</b>	10 15	
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259	% 26-5 6 cover) ameter) % 26-5	5 <b>0%</b>	ment) 51-75% 51-75%		Gravel Sand Silt Clay <b>Habita</b> (% of effe		>2-64mm >0.06-2mr 0.004-0.06 <0.004mm s sample	n Smm e <b>d</b>	10 15	30
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259	% 26-5	5 <b>0%</b> 50% , leaves	ment) 51-75% 51-75%		Gravel Sand Silt Clay <b>Habita</b> (% of effo Stones:	ort)	>2-64mm >0.06-2mr 0.004-0.06 <0.004mm s sample	n imm i <b>:d</b> 6 Ri	10 15 10	
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259	%     26-5       6 cover)       ameter)       %     26-5       wood, sticks,       %     26-5	5 <b>0%</b> 50% , leaves	ment) 51-75% 51-75% s etc., >1mm)	>75%	Gravel Sand Silt Clay <b>Habita</b> (% of effo Stones: Wood:	ort)	>2-64mm >0.06-2mr 0.004-0.06 <0.004mr s sample 509 109	n imm i <b>:d</b> 6 Ri 6 Ri	10 15 10	60
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259	%         26-5           6 cover)         ameter)           %         26-5           wood, sticks,         %           %         26-5           leposits         4	50% 50% , leaves 50%	ment) 51-75% 51-75% s etc., >1mm)	>75%	Gravel Sand Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges:	brt) hyte:	>2-64mm >0.06-2mr 0.004-0.06 <0.004mr s sample 509 109 9	n imm i <b>:d</b> 6 Ri 6 Ri 6 Pi	10 15 10 iffles: uns: pools:	60
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic c <5% 5-259	%     26-5       6 cover)     ameter)       %     26-5       wood, sticks,     26-5       %     26-5       %     26-5	50% 50% , leaves 50% 50%	ment) 51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges:	hyte:	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm 6 6 Ri 6 Ri 6 Ri 6 Pi 8 s retu	10 15 10 iffles: uns: pools:	60
(% gravel-boulder particle         <5%	%         26-5           6 cover)         ameter)           %         26-5           wood, sticks,         6           %         26-5           deposits         6           %         26-5           deposits         6           %         26-5           deposits         6           %         26-5           %         26-5	50% 50% , leaves 50% 50%	ment) 51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number	hyte: • of inv	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm i i i i i i i i i i i i i i i i i	10 15 10 ffles: uns: pols: urned:	60
(% gravel-boulder particle         <5%	%         26-5           ameter)         %           %         26-5           wood, sticks,         26-5           %         26-5           deposits         %           deposits         %	50% 50% 50% 50% 50% bed are	ment) 51-75% 51-75% s etc., >1mm) 51-75% 51-75%	>75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges: Number Koura: 8	hyte: • of inv	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm i i i i i i i i i i i i i i i i i	10 15 10 ffles: uns: pols: urned: nps: 0	60
(% gravel-boulder particle         <5%	%         26-5           ameter)         %           %         26-5           wood, sticks,         26-5           %         26-5           deposits         %           deposits         %	50% 50% 50% 50% 50% bed are	ment) 51-75% 51-75% 51-75% 51-75% 51-75%	>75% >75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: & Crabs: 0	hyte: of inv	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm i i i i i i i i i i i i i i i i i	10 15 10 ffles: uns: pols: urned: nps: 0	60
(% gravel-boulder particle <5% 5-25% Organic material (% Large wood (>10cm di <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic co <5% 5-25% Instream plant cover	%         26-5           ameter)         %         26-5           %         26-5         %           // 26-5         %         26-5           // 1eposits         %         26-5           // 26-5         %         26-5           // 1eposits         %         26-5           // 26-5         %         26-5           // 26-5         %         26-5           // 26-5         %         26-5	50% , leaves 50% 50% bed are	ment) 51-75% 51-75% 51-75% 51-75% 51-75%	>75% >75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: & Crabs: 0 Other: 0	hyte: of inv 33 type:	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm 6 Ri 6 Ri 6 Ri 6 Ri 6 Ri 8 Strir Shrir	10 15 10 ffles: uns: pols: urned: nps: 0	30 60 10
(% gravel-boulder particle <5% 5-259 Organic material (% Large wood (>10cm di <5% 5-259 Coarse detritus (small <5% 5-259 Fine (<1mm) organic d <5% 5-259 Instream plant cove Filamentous algae & n <5% 5-259	%         26-5           ameter)         %         26-5           %         26-5         %           // 26-5         %         26-5           // 1eposits         %         26-5           // 26-5         %         26-5           // 1eposits         %         26-5           // 26-5         %         26-5           // 26-5         %         26-5           // 26-5         %         26-5	50% , leaves 50% 50% bed are	ment) 51-75% 51-75% 51-75% 51-75% 51-75%	>75% >75% >75%	Gravel Sand Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: & Crabs: 0 Other: C	hyte: of inv 33 type:	>2-64mm >0.06-2mr 0.004-0.0e <0.004mr <b>s sample</b> 509 109 9 409	n imm 6 Ri 6 Ri 6 Ri 6 Ri 6 Ri 8 Strir Shrir	10 15 10 ffles: uns: cools: urned: nps: 0 sels: 0	60

Stream name: Piakon	ui Str	aam			Shee			c	Sito n	umh	اح .	53 15	5							
Sample number: 5	ui sti	eann		Δ	55655	or l	osh S		bite i	unib	er. 73			· 4/0	3/20	15				
Sample number. S				~	33633	01.3	0311 0	iiiiiiii		Cate	egory		Dute	. 470	5720.	15				
Habitat parameter		С	ptim	al			Sub	ooptii	mal	ourc	.60.1		argin	al				Poor	ſ	
1. Riparian vegetative zone width	•	>10n	tatior n inuou	n buffe Is &	er	•	Bank veget <10m Most	tation			•	Pathy and/o Most	or sto	ck		•		iks fre nan ac ous	•	:
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:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17.5																				
2. Vegetative protection	•	imme zone nativ Trees shrul wood prese Vege	ediate s cove re veg s, und bs or r dy pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	s may red by	ainly etatio evide be	n ent	•	Bank cover of gra black & intr speci Vege disru Bare cropp comr	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrub , willo ed obvio losely	us	• • •	cove & sh Disre strea vege high Gras graz Sign	s hea	y gras i of nk i very vily : stock	¢
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:15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17.5																				
3. Bank stability	•	Erosi failui abse	nt/mi of bai	ank nimal		•	Infre areas	of er ly hea 6 of b	, sma osion iled o	II	•	Mode unsta 30-60 reach erosid High poter flood	ible )% of i has a on erosic ntial d	bank areas	of	•	Mar 60-1	able ny erod 00% c erosio	of ban	k
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	•	frequ Dista riffle strea	uent ince b s divio im wio	tively etwee ded by dth=5 habita	en / -7	•	Dista riffle:	s infre	equen etwee led by	en /	•	Occas run Botto provi habit Dista riffles strea 25	om co de so at nce b s divic	ntour me etwee led by	s en	•	wate riffle Poor Dista riffle	erally er, sha es r habit ance b es divio am wig	at etwee ded by	y
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	•	chan abse Strea		redgir nimal th	ng	•	chan Evide chan Rece chan	nel/dr	redgir of past redgir redgir	ng t ng	•	Chan chang exter Emba ing st prese banks 40-80 Chan	ges/di isive inkme iructu int on 5 0% of	ents/s res both reach	hor	•	gabi >809 reac or d Instr	ks sho on/ce % of st h chai srupto ream h red/at	ment ream nneliz ed nabita	ed

Habitat parameter			itego			На	bitat	para	mete	r			itego			На	bitat	para	mete	r
6. Sediment deposition	•	O Little, point <20% affect sedin depo	bars of bo ted by nent	lands prese ottom /	nt	•	form from or fin 20-50 affec	ation, grave le sed 0% of ted t depo	ase in most l, san liment botto psitior	ly d : m	•	O Some new g fine s old & 50-80 affect Sedin at ob const bend	gravel edim new 0% of ted nent o struct rictio	osition I, sand ent or bars botto depos tions,	dor า m	•	fine r Incre devel >80% chang frequ Pools abser sedin	ased opme of bo ging ently almo nt due	bar ent ottom ost e to	
Score: 11 7. Velocity/depth regimes	20 •	19 4 velo regim Slow/ fast/s fast/s	nes pr /deep /shallo shallo	esent , ow,		15 •	regin If fas	tity/de nes pr t/shal	12 epth resent low is en sco		10 •	9 2 of 4 veloc regim If fast slow/ missi	ity/de nes pr t/shal (shallo	esent low o ow are	r e	•	4 Domi veloc regin Usua	ity/de ne		
Score: 15 8. Abundance & diversity of habitat	20 •	19 >50% favou inver colon variet debri mats Snags logs/t banks provi fish c Must trans	irable tebra isatio ty of v s, riffl s/ sub under s/cob des al over not b	for te woody es, ro merg cut bles bunda	ed ant	15 • •	favou inver color Snags logs/ bank Fish o Mode of ha Can o	urable tebra hisatic s/ sub under s/cob cover erate bitat	te omerg rcut bles comn variet types t of so	ed non y	10 • •	9 10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra isatio cover 0% sul y mov dy del ay be hered	for te patch bstrat ed by bris ra	y e	5 • •	abser Subst or lac Stabl lackir	irable tebra iisatic cover nt crate king e hab	for te on rare c unstal itats limite	ble
Score: 18 9. Periphyton	•	19 Perip evide held s (mac wood sedin	nt on substr rophy l etc.,	hand rates tes,		•	visibl subst	rates		11	10 •	9 Perip <20% availa	cove	r of		•	& pro	lific cove	2 n obvio er of ubstra	
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 151																				

Stream name. Falakan	ahi Stream			Assesso	r: Josh	Smith			
Site number: 718_5	San	nple number: 6		Date: 6/	03/20	15	Time:	11:00	
GPS coordinates	Dov	wnstream:		E 18410	27		N 586	57879	
	Ups	stream:		E 18410	98		N 586	57799	
Channel & riparian	features			Instrea	m hye	draulic co	ndit	ions	
Canopy cover:				Estimate	d or me	asured read	h ave	rage:	
Open	Partly shade	d Very sł	haded						
Fencing:	Dominant ripar	an vegetation:		Stream	width	(active cha	nnel)	: 6.5 m	
None/ineffective	Crops	Retired veg	etation	Stream	width	(water): 3.	5 m		
One side/partial	Pasture	Native shru	ıb	Stream	depth:	0.25 m			
Complete	Exotic trees	Native tree	S	Surface	velocit	y: 0.15 m	<b>S</b> <sup>-1</sup>		
Water quality									
Temperature:	16.4	°C		Conduct	tivity:		118.7	΄ μ	S cm <sup>-1</sup>
Dissolved oxygen:	58.2	%		5.71			mg l-1		
Turbidity:	Clear	Slightly turbid	Highly t	urbid	Stair	ied	(	Other	
Stream-bottom sub	strata								
Compaction (inorgani	c substrata):			% surfic		rganic sub	strat	um size	
Assorted sizes tightly	packed &/or over	lapping		Substrat	tum	Dimensi	on	Percer	ntage
Moderately packed wi	th some overlapp	ing		Bedrock	:	-			
Mostly a loose assortn	nent with little ov	erlap		Boulder		>256mm		15	
No packing/loose asso	rtment easily mo	ved		Cobble		>64-256mr	n	71	
Embeddedness:				Gravel		>2-64mm		10	
(% gravel-boulder particle	es covered by fine se	diment)		Sand		>0.06-2mm	n	2	
<5% 5-25%	<b>6</b> 26-50%	51-75%	>75%	Silt		0.004-0.06	mm	2	
,	I			Clay		<0.004mm			
Organic material (%	cover)			Habita	t type	s sample	d		
Large wood (>10cm di	ameter)			(% of effo	ort)				
<b>&lt;5%</b> 5-25%	6 26-50%	51-75%	>75%	Stones:		70%	5		
Coarse detritus (small	wood, sticks, leav	es etc., >1mm)		Wood:		%	Rif	fles:	20 %
< <b>5%</b> 5-25%	6 26-50%	51-75%	>75%	Macrop	hyte:	%	Ru	ns:	65%
Fine (<1mm) organic d	leposits			Edges:		30%	Po	ols:	15%
< <b>5%</b> 5-25%	% 26-50%	51-75%	>75%	Number	of inv	ertebrates	s retu	rned:	
Instream plant cove	er (% streambed a	irea)		Koura: 3	84		Shrim	ips: 3	
Filamentous algae & n	nats:			Crabs: 0	1		Muss	els: 0	
<5% 5-25%	6 26-50%	51-75%	>75%	Other:					
Macrophytes:				Mussel	type:				
<b>&lt;5%</b> 5-25%	6 26-50%	51-75%	>75%	Hyridell	a		Cucur	merunio	
Mosses/liverworts:									
interverter.		51-75%	>75%	1		1			

Wadeable Hard-Bot Qualitative Habitat Ass					Shee	et														
Stream name: Paiakara	ahi S	tream	ı					9	Site n	umb	er: 7	18_5								
Sample number: 6				A	ssess	or: J	osh S	mith					Date	: 6/0	3/20	15				
Habitat parameter		0	ptim	al			Sub	oopti	mal	Cate	gory		argin	nal				Poo	ſ	
1. Riparian vegetative zone width	•	Bank	side tation n nuou	n buffe	er	•	Bank veget <10m	side tation	buffe		•	Pathy and/o	ways p or sto	orese		•		aks fre nan ac	quent	:
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:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18.5																				
2. Vegetative protection	•	imme zone nativ Trees shrut wood prese Vege	ediate s cove e veg s, und os or i ly pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	cover of gra black & int speci Vege disru Bare	asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrub , willo ed	os, ow ous	•	cove & sh Disr strea vege high Gras graz Sign	s hea	y gras of nk very vily	¢
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:19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 18.5																				
3. Bank stability	•	Erosi failur	e nt/mi of bar	ank nimal		•	Infre areas most	eratel quent s of er ly hea % of b ed	, sma osion iled o	II	•	unsta 30-60 reach erosi High	0% of has a on erosic htial d	bank areas	of	•	Mar 60-1	table iy eroi .00% c erosio	of ban	k
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	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee ded by dth=5 habita	en / -7	•	riffle: Dista riffle:	rrenco s infre nce b s divic m wic	equen etwee led by	en /	•	run Botto provi habit Dista riffles	om co de so at nce b s divic		s en /	•	wate riffle Poo Dist riffle	erally er, sha es r habit ance b es divi am wi	at etwee ded by	y
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	•	abse Strea	nel/di nt/mi	redgir nimal th		•	chan Evide chan Rece chan	e char nel/di ence o nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	•	exter Emba ing st prese banks 40-80	ges/d nsive ankme ructu ent on s 0% of nelize	res both reach	hor	•	gabi >80 reac or d Insti	ks sho on/ce % of st h chai isrupt ream f red/at	ment ream nneliz ed nabita	ed
Score: 19	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter		Ca	itego	ory		На	bitat	para	mete	r		Ca	atego	ory		Ha	bitat	para	mete	r
Habitat parameter		0	ptim	al								0	ptim	al						
6. Sediment deposition	•	point	bars of bo ted by nent		nt	•	form from or fin 20-50 affec	ation, grave e sed 0% of ted t depo	ase in most in san iment botto ositior	ly d t m	•	Some new g fine s old & 50-80 affect Sedin at ob const bend	grave edim new 0% of ted nent o struct	l, sand ent or bars botto depos tions,	dor n m	•	fine r Incre deve >80% chan; frequ Pools abset sedin	mater ased lopme of bo ging lently almo nt due	bar ent ottom ost e to	
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	•		nes pr /deep /shallo shallo	ow,		•	regin If fas	ity/de nes pr t/shal ng the	epth esent low is en sco		•	2 of 4 veloc regim If fast slow/ missi	ity/de nes pr t/shall (shallo	iesent low o ow are	r e	•	veloc regin	ity/de ne	l by 1 epth ep/slo	
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	•	variet debri mats Snags logs/ banks provi fish c	irable tebra isatic ty of v s, riff s/ sub under s/cob des a over not b	for te on & w woody les, ro omerg cut	ed ant	•	favou inver color Snag logs/ bank Fish o Mode of ha Can o	urable tebra nisatic s/ sub under s/cob cover erate bitat	te on rcut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	urable tebra iisatic cover 0% su y mov dy del ay be herec	for te patch bstrat ed by bris ra	y e	•	favou inver color Fish o abset Subst or lao Stabl lackin	nt trate tking e hab	for te n rare c unstal itats limite	ble
Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	held : (mac	nt on subst rophy l etc.,	hand rates		•	visibl subst	rates		n	•	Perip <20% availa	, cove	r of		•	& pro	olific cove	n obvi er of ubstra	
Score: 4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE:146																				

Stream name: Kareng	orengo Strea	m			Assesso	or: Josh	Smith			
Site number: 232_3		Sampl	e number: 7		Date: 3	/03/20	15	Time	: 13:40	
GPS coordinates		Down	stream:		E 18483	393		N 582	23235	
		Upstre	eam:		E 18484	123		N 582	23069	
Channel & riparian	features				Instrea	ım hyo	draulic co	ondit	ions	
Canopy cover:					Estimate	d or me	asured read	h ave	rage:	
Open	Partly s	haded	Very	shaded						
Fencing:	Dominant	riparian	vegetation:		Stream	width	(active cha	nnel	): 5.0 m	
None/ineffective	Crops		Retired ve	getation	Stream	width	(water): 2.	0 m		
One side/partial	Pasture		Native shr	ub	Stream	depth:	0.50 m			
Complete	Exotic tree	S	Native tree	es	Surface	velocit	y: 0.60 m	S-1		
Water quality										
Temperature:	15.6		°C		Conduc	tivity:		146.0	) μ	S cm <sup>-1</sup>
Dissolved oxygen:	70.0		%		7.03			mg l <sup>-:</sup>	1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ied		Other	
Stream-bottom sub Compaction (inorgan					% surfi	ial ino	rganic sub	strat	um size	
					compos		Dimensi		Devee	
Assorted sizes tightly					Substra		Dimensi	on	Percer	itage
Moderately packed w					Bedrocl Boulder		>256mm			
Mostly a loose assort No packing/loose ass			-		Cobble		>64-256mr	n		
Embeddedness:	or timent easi	iy move	u		Gravel		>2-64mm			
(% gravel-boulder particl	es covered by f	ine sedin	nent)		Sand		>0.06-2mm	n	90	
<5% 5-25		. 1	51-75%	>75%	Silt		0.004-0.06	mm	10	
			01,0,0	. , 0, 0					10	
					Clay		<0.004mm			
Organic material (%	•						s sample	d		
Large wood (>10cm d	т. <sup>1</sup>	I	I		(% of eff			.1		
< <b>5%</b> 5-25	·		51-75%	>75%	Stones:		%			
Coarse detritus (small	i i	1		. 750/	Wood:	h. 1	%		ffles:	%
< <b>5%</b> 5-25	I	50%	51-75%	>75%	Macrop	nyte:	50%		ins:	100%
Fine (<1mm) organic	· 1	-0%	F1 7F0/	> 75.0/	Edges:	r of inv	50%		ols:	%
<5% 5-25			51-75%	>75%			ertebrates			
Instream plant cov		bed are	a)		Koura:				nps: 0	
Filamentous algae & r	1	- 00⁄		~ 750/	Crabs: (	J		IVIUSS	els: 0	
<5% <b>5-25</b>	<b>%</b> 26-5	00%	51-75%	>75%	Other:	tura				
Macrophytes: <5% 5-25	% 26-!	-0%	51-75%	<b>∖7</b> E9∕	Mussel			Curr	morunia	
I	/0 20-	50%	31-12%	>75%	Hyrideli	u		cucu	merunio	
Mosses/liverworts:	% 26-5	5.0%	51-75%	>75%						
	/0 20-3	0/0	31-13/0	~1570						

Right bank:4       20       19       18       17       16       15       14       13       12       11       10       9       8       7       6       5       4       3       2       1         Mean:4       Image: State Sta			ient	Field	Dutt	JIE	26														
Habitat parameter         Optimal         Suboptimal         Marginal         Vesteration         Suboptimal         Marginal         Pathways present vegetative zone width         Bankside vegetative zone width         Pathways present vegetative zone width         Bankside vegetative protection         Pathways present vegetative densitive zone width         Banksufaces vegetative protection         Bank sufaces shrubs or non- mative vegetation present vegetation present         Bank sufaces vegetative shrubs or non- tive vegetation present         Bank sufaces vegetative shrubs or non- present         Bank sufaces shrubs or non- present         Bank sufaces vegetative shrubs or non- present         Bank sufaces vegetation vegetation vegetation vegetation vegetation vegetation vegetation vegetation present         Bank sufaces vegetation vegetation vegetation vegetation vegetation veget	Stream name: Karengo	oreng	go St	ream					5	Site n	umb	er: 23	32_3								
Habitation parameter         Optimal         Suboptimal         Marginal         Partways present and/or stock         Braiks frequent and/or stock         Braiks frequent an	Sample number: 7				A	ssess	or: J	osh S	mith					Date	: 3/0	3/20	15				
Optimal         Sankside         Bankside         Bankside         Bankside         Bankside         Bankside         Bankside         Bankside         Bankside         Pathways present and/or stock         Pathways present and/or stock         Bankside         Bankside         Bankside         Bankside         Pathways present and/or stock         Bankside         Pathways present and/or sto	Habitat paramotor										Cate	gory									
vegetative zone width       -	habitat parameter			Optim	nal			Sub	oopti	mal			Μ	argin	nal				Poor	-	
Right bank:6       20       19       18       17       16       15       14       13       12       11       10       9       8       7       6       5       4       3       2       1         Mean: 6.5	vegetative zone		veg >10 Con	etation m tinuou		er		veget <10m	tation				and/o	or sto	ck			Hum	an ac		
Mean: 6.5Mean: 6.5 <td>Left bank:7</td> <td>20</td> <td>19</td> <td>18</td> <td>17</td> <td>16</td> <td>15</td> <td>14</td> <td>13</td> <td>12</td> <td>11</td> <td>10</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td>	Left bank:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2. Vegetative protection <ul> <li>Bank surfaces &amp; immediate riparian protection</li> <li>Trees, under-storey native vegetation</li> <li>Trees, under-storey moody plants present</li> <li>Vegetative disruption minimal</li> </ul> Bank surfaces covered mainly by native vegetation <li>Trees, under-storey moody plants present</li> <li>Vegetative disruption minimal</li> Bank surfaces covered by exotive forestry <ul> <li>Bank surfaces covered by mixture species</li> <li>Vegetative disruption of stream bank vegetation very high</li> <li>Grass heavily grazed</li> <li>Vegetative disruption for stream bank</li> <li>Vegetative disruption for stream bank</li> </ul> <ul> <li>Bank surfaces covered by exotive forestry</li> <li>Vegetative disruption for stream bank</li> </ul> <ul> <li>Vegetative disruption for stream bank</li> <li>Vegetative disruption for stream babatiditi</li> <li>Vegetative disrupti</li></ul>	Right bank:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
protection       immediate riparian zones covered by mative vegetation native vegetation native vegetation.       covered by expetition of grasses/strubs, blackberry, willow & fintroduced species.       covered by expetition of grasses/strubs.       covered by mittie of grasses/strubs.       covered by m	Mean: 6.5																				
Right bank:4       20       19       18       17       16       15       14       13       12       11       10       9       8       7       6       5       4       3       2       1         Mean:4       -       <	•	•	imm zon nati Tree shru woo pres Veg	nediate es cove ve veg es, unc ubs or ody pla sent etative	e ripar ered b etatic ler-sto non- ints	rian 9y 9n 9rey	•	cover nativ Disru Bank cover	red m e veg ption s may red by	ainly etatio evide be	n ent	•	cover of gra black & inte speci Vege disru Bare cropp	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shruk , willo :ed obvio losely	os, ow ous	•	cove & sh Disru strea vege high Gras graze Signi	red by rubs uption im ba tatior s heav ed ficant	y gras: of nk very vily	
Mean:4Image: Note of the state	Left bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability       •       Banks stable       •       Moderately stable       •       Moderately stable       •       Moderately stable       •       Many eroded areas         3. Bank stability       •       Frosion/bank failure absent/minimal areas of erosion mostly healed over       •       So-60% of bank in reach has areas of erosion potential during floods       •       Many eroded areas       60-100% of bank has erosion potential during floods         Left bank:4       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: 4	Right bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Mean:4										1					1					
Right bank:42019181716151413121110987654321Mean: 4Mean: 44. Channel sinuosity•Bends increase stream length 3-4 times longer than if it was straight•Bends increase stream length 2-3 times longer than if it was straight•Bends increase stream length 2-3 times longer than if it was straight•Bends increase stream length 1-2 times longer than if times longer than if times	3. Bank stability	•	Eros failu abso <5%	sion/ba ire ent/mi of ba	ank inimal		•	Infree areas most 5-309	quent s of er ly hea % of b	, sma osion iled o	II	•	unsta 30-60 reach erosia High poter	able 0% of n has a on erosic ntial d	bank areas	of	•	Man 60-1	y eroo 00% c	of ban	k
Mean: 4       Image: Stream length 3-4 times longer than if it was straight       Bends increase stream length 2-3 times longer than if it was straight       Bends increase stream length 2-3 times longer than if it was straight       Bends increase stream length 2-3 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer than if it was straight       Bends increase stream length 1-2 times longer	Left bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
4. Channel sinuosity       • Bends increase stream length 3-4 times longer than if it was straight       • Bends increase stream length 2-3 times longer than if it was straight       • Bends increase stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Channel stream length 1-2 times longer than if it was straight       • Some changes to channel/dredging absent/minimal       • Some changes to channel/dredging absent/minimal       • Some changes to channel/dredging normal pattern       • Stream with normal pattern       • Stream with normal pattern       • Stream channel/dredging not present       • Channel does not present       • Stream channel/dredging not present       • Stream cha	Right bank:4	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Mean: 4																				
5. Channel alteration       • Changes to channel/dredging absent/minmal       • Some changes to channel/dredging absent/minmal       • Channel channel/dredging bevidence of past channel/dredging normal pattern       • Some changes to channel/dredging • Evidence of past channel/dredging not present       • Channel changes/dredging extensive       • Banks shored with gabion/cement         • Stream with normal pattern       • Recent channel/dredging not present       • Channel channel/dredging not present       • Channel channel/dredging present on both banks       • Banks shored with gabion/cement	4. Channel sinuosity	•	stre time	am ler es long	ngth 3 ger tha		•	strea times	m len s long	gth 2- er tha		•	strea times	m len i long	gth 1 er tha		•	Char	inel st	raight	t
alteration channel/dredging absent/minimal Stream with normal pattern Recent channel/dredging not present Augustation channel/dredging not present channel/dredging not present Augustation channel/dredging not present channel/dredging not present Augustation channel/dredging not present Augustation channel/dredging not present Augustation channel/dredging not present Augustation altered/absent	Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
			cha abso Stre	nnel/d ent/mi am wi	redgir inimal th	0	•	chan Evide chan Recei chan	nel/di ence c nel/di nt nel/di	redgir of past redgir redgir	ng : ng	•	chang exter Emba ing st prese banks 40-80 chang	ges/d nsive ankme ructu ent on s 0% of nelize	ents/s res i both reach	hor	•	gabio >80% react or di Instr	on/ce 6 of st h char srupte eam h	ment ream nnelize ed nabita	ed
		<u> </u>	10	10	17	16	15	14	13	12	11	10			7	6	5	4	2	2	

Habitat parameter		Ca	atego	ory		Ha	bitat	para	mete	r		Ca	atego	ory		Ha	bitat	par	amete	er
		С	ptim	al								0	ptim	al						
6. Sediment deposition	•	point <20% affec sedir	/no is bars of bo ted by nent sition	prese ottom /	nt	•	form from or fin 20-50 affec	ation, grave le sed 0% of ted t depo	ase in most el, san iment botto ositior	ly d t m	•	new fine s old & 50-80 affec Sedin at ob	grave edim new 0% of ted nent struc	botto depos tions,	d or n vm	•	fine Incre deve >80% chan frequ Pool	mate asec lopr 6 of ging uent s aln nt d	d bar nent botton ly nost ue to t	
Score:9	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	•	Large large smal	s even e/shal /deep l/shall l/deep	low, ), low,	ked	•	large	/deep few s	f pool ) hallov		•	Preva shallo				•			of poc allow	ls
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	•	favou inver color varie debr mats Snag logs/ bank provi fish c	s/ sub under s/cob des a cover	for te wood les, ro merg cut bles bunda	y oot ed ant	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	urable tebra hisatic s/ sub under s/cob cover erate bitat	te omergo cut bles comm variet types. t of sc	ed non sy	•	favou inver color Fish o 60-90 easily foot Wood	urable tebra iisatic cover )% su / mov dy de ay be herec	te patch bstrat red by bris ra	iy e	•	favo inver color Fish abse Subs or la Stab	urab tebi nisat cove nt trate cking le ha ng o	ion r rare unsta bitats r limite	or ible
Score: 6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	•	evide held Stabl	hytor ent on stone e sub ces ro	hand s strate		•	visibl Stabl	e sub hytor	n not stones strate n obvie		•	<20%	, cove	n visib er of ubstra		•	& pr >209	olific 6 cov	on obv ver of substr	
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 82.5			<u>.</u>	<u>.</u>		•	-	<u>.</u>		<u>.</u>	<u>.</u>	•				•			•	·

Stream name: Wairer	e Stream				Assesso	r: Josh	Smith			
Site number: 1224_5		Samp	le number: 8		Date: 3/	/03/20	15 .	Time	: 9:30	
GPS coordinates		Dowr	nstream:		E 18516	49	<b>I</b>	N 58	19801	
		Upstr	eam:		E 18517	19	I	N 58	19721	
Channel & riparian	features				Instrea	m hyo	draulic co	ndit	ions	
Canopy cover:					Estimate	d or me	asured reac	h ave	rage:	
Open	Partly sl	haded	Very sl	haded						
Fencing:	Dominant	ripariar	n vegetation:		Stream	width	(active cha	nnel	): 8.5 m	
None/ineffective	Crops		Retired veg	etation	Stream	width	(water): 5.	0 m		
One side/partial	Pasture		Native shru	ıb	Stream	depth:	0.35 m			
Complete	Exotic tree	S	Native tree	s	Surface	velocit	y: 0.10 m	S <sup>-1</sup>		
Water quality	-1									
Temperature:	15.5		°C		Conduc	tivity:		66.5	μ	cm <sup>-1</sup>
Dissolved oxygen:	69.2		%		6.91			mg l-	1	
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stain	ied		Other	
Stream-bottom sul	ostrata					1				
Compaction (inorgan	ic substrata):				% surfic compos		rganic sub	strat	um size	
Assorted sizes tightly	packed &/or (	overlap	ping		Substra	tum	Dimensi	on	Percen	tage
Moderately packed w	vith some ove	erlappi	ng		Bedrock	:	-		2	-
Mostly a loose assort	nent with litt	le over	lap		Boulder		>256mm		10	
No packing/loose asso	ortment easily	y move	d		Cobble		>64-256mn	n	5	
Embeddedness:					Gravel		>2-64mm		15	
(% gravel-boulder particl	es covered by fi	ine sedir	ment)		Sand		>0.06-2mm	ı	20	
<5% <b>5-25</b>	% 26-5	50%	51-75%	>75%	Silt		0.004-0.06	mm	2	
I	I		1 1		Clay		<0.004mm			
					Habita	t type	s sample	d		
Organic material (9	6 cover)									
Organic material (% Large wood (>10cm d					(% of effo	ort)				
-	iameter)	50%	51-75%	>75%		ort)	60%			
Large wood (>10cm d	iameter) % 26-5		I I	>75%	(% of effo	ort)	60% %		ffles:	109
Large wood (>10cm d	iameter) % 26-5 wood, sticks,	, leaves	I I	>75%	(% of effo	·		Ri	ffles: uns:	10% 30%
Large wood (>10cm d < <b>5%</b> 5-25 Coarse detritus (small < <b>5%</b> 5-25	iameter) % 26-5 wood, sticks, % 26-5	, leaves	s etc., >1mm)		(% of effo Stones: Wood:	·	%	Ri Ri		309
Large wood (>10cm d < <b>5%</b> 5-25 Coarse detritus (small < <b>5%</b> 5-25	iameter) % 26-5 wood, sticks, % 26-5 deposits	, leaves	s etc., >1mm)		(% of effo Stones: Wood: Macrop Edges:	hyte:	% %	Ri Ru Po	uns: pols:	
Large wood (>10cm d < <b>5%</b> 5-25 Coarse detritus (small < <b>5%</b> 5-25 Fine (<1mm) organic ( < <b>5%</b> 5-25	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5	, leaves 50% 50%	s etc., >1mm) 51-75% 51-75%	>75%	(% of effo Stones: Wood: Macrop Edges:	hyte:	% % 40% ertebrates	Ri Ru Po retu	uns: pols:	309
Large wood (>10cm d < <b>5%</b> 5-25 Coarse detritus (small < <b>5%</b> 5-25 Fine (<1mm) organic < <b>5%</b> 5-25 Instream plant cov	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 <b>er</b> (% stream)	, leaves 50% 50%	s etc., >1mm) 51-75% 51-75%	>75%	(% of effo Stones: Wood: Macrop Edges: Number	hyte: r of inv	% 40% ertebrates :	Ri Ru Po s retu Shrin	uns: pols: irned:	309
Large wood (>10cm d < <b>5%</b> 5-25 Coarse detritus (small < <b>5%</b> 5-25 Fine (<1mm) organic < <b>5%</b> 5-25 Instream plant cov	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 <b>er</b> (% streaml mats:	, leaves 50% 50% bed are	s etc., >1mm) 51-75% 51-75%	>75%	(% of effo Stones: Wood: Macrop Edges: Number Koura: 1	hyte: r of inv	% 40% ertebrates :	Ri Ru Po s retu Shrin	uns: ools: urned: nps: 6	309
Large wood (>10cm d           <5%	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 <b>er</b> (% streaml mats:	, leaves 50% 50% bed are	s etc., >1mm) 51-75% 51-75% 2a)	>75% >75%	(% of effo Stones: Wood: Macrop Edges: Number Koura: 1 Crabs: 0	hyte: r of inv L5	% 40% ertebrates :	Ri Ru Po s retu Shrin	uns: ools: urned: nps: 6	309
<5%	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 <b>er</b> (% streaml mats: % 26-5	, leaves 50% 50% bed are	s etc., >1mm) 51-75% 51-75% 2a)	>75% >75%	(% of effo Stones: Wood: Macrop Edges: Number Koura: 1 Crabs: 0 Other: 0	hyte: of inv 15 ) type:	% 40% ertebrates	Ri Ru Po s retu Shrin Muss	uns: ools: urned: nps: 6	30%
Large wood (>10cm d <5% 5-25 Coarse detritus (small <5% 5-25 Fine (<1mm) organic <5% 5-25 Instream plant cov Filamentous algae & r <5% 5-25 Macrophytes:	iameter) % 26-5 wood, sticks, % 26-5 deposits % 26-5 <b>er</b> (% streaml mats: % 26-5	, leaves 50% 50% bed are	s etc., >1mm) 51-75% 51-75% sa) 51-75%	>75% >75% >75%	(% of effo Stones: Wood: Macrop Edges: Number Koura: 1 Crabs: 0 Other: 0 Mussel	hyte: of inv 15 ) type:	% 40% ertebrates	Ri Ru Po s retu Shrin Muss	uns: pols: irned: nps: 6 sels: 0	30%

Wadeable Hard-Bo Qualitative Habitat As					Shee	et																		
Stream name: Wairere stream							Site number: 1224 5																	
Sample number: 8	Asses					sor: Josh Smith Date: 3/03/2015																		
Habitat parameter	Optimal						Category Suboptimal Marginal											Poor						
1. Riparian vegetative zone width	<ul> <li>Bankside vegetation buffer &gt;10m</li> <li>Continuous &amp; dense</li> </ul>					•	<10m	tation			•	Pathy and/o Most	or sto	ck	<ul> <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:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Mean: 14																								
2. Vegetative protection	<ul> <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>						cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	ent	•	of gra black & intr speci Vege disru Bare	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shrut , willc ed n obvio	os, ow ous	<ul> <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:7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
3. Bank stability	<ul> <li>Banks stable</li> <li>Erosion/bank failure absent/minimal</li> <li>&lt;5% of bank affected</li> </ul>					<ul> <li>Moderately stable</li> <li>Infrequent, small areas of erosion mostly healed over</li> <li>5-30% of bank eroded</li> </ul>					<ul> <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> <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:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				
Mean: 13.5			1				1	1	1					1	1									
4. Frequency of riffles	<ul> <li>Riffles relatively frequent</li> <li>Distance between riffles divided by stream width=5-7</li> <li>Variety of habitat is key</li> </ul>					•	riffles Dista riffles	rrenco s infre nce b s divic m wic	equen etwee led by	en /	<ul> <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> <li>Generally flat water, shallow riffles</li> <li>Poor habitat</li> <li>Distance between riffles divided by stream width=&gt;25</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> <li>Changes to channel/dredging absent/minimal</li> <li>Stream with normal pattern</li> </ul>					•	chan Evide chan Recei chan	e char nel/di ence c nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	<ul> <li>Channel changes/dredging extensive</li> <li>Embankments/shor ing structures present on both banks</li> <li>40-80% of reach channelized &amp; disrupted</li> </ul>						<ul> <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:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1				

Habitat parameter			atego ptim			Ha	bitat	para	mete	r	Category Optimal						Habitat parameter					
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted b		nt	•	forma from or fin 20-50 affec	t depo	most el, san iment botto	ly d t m	•	Some new § fine s old & 50-80 affect Sedin at ob const bend	grave edim new 0% of ted nent o struct	l, sand ent of bars botto depos tions,	d or n om	<ul> <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 7. Velocity/depth	20 •	19 18 17 10 4 velocity/depth			16	15 •	14 3 Of 4	13	12	11	10	9 2 of 4	8	7	6	5	4 Dom	3 inate	2 d by 1	1		
regimes	<ul> <li>Slow/deep, slow/shallow, fast/shallow, fast/deep</li> </ul>					•	veloc regin If fas	tity/de nes pr t/shal ng the	esent low is		<ul> <li>2014 velocity/depth regimes present</li> <li>If fast/shallow or slow/shallow are missing, score low</li> </ul>					<ul> <li>Dominated by 1 velocity/depth regime</li> <li>Usually deep/slow</li> </ul>						
Score: 16	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	•	varie debri mats Snags logs/ banks provi fish c	urable tebra iisatic ty of s, riff s/ sub under s/cob des a over not b	e for te on & v wood les, ro omerg rcut	y oot ed	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	0% su urable tebra hisatic s/ sub under s/cob cover erate bitat consis mater	for te on cut bles comn variet types t of so	ed non sy	<ul> <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> <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	•	evident on hand held stones • Stable substrate					<ul> <li>Periphyton not visible on stones</li> <li>Stable substrate</li> <li>Periphyton obvious to touch</li> </ul>					Perip <20% availa	r of		<ul> <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 117																						

Stream name: Waitea	riki stream				Assesso	r: Josh	Smith			
Site number: 1430_10	)	Samp	ole number: 9		Date: 4,	/03/20	15 1	Time: 1	10:00	
GPS coordinates		Dowi	nstream:		E 18525	66	1	N 5818	3150	
		Upsti	ream:		E 18526	97	1	V 5818	3212	
Channel & riparian	features				Instrea	m hye	draulic co	nditio	ons	
Canopy cover:					Estimate	d or me	asured reac	h avera	ige:	
Open	Partly s	haded	Very sl	naded						
Fencing:	Dominant	riparia	n vegetation:		Stream	width	(active cha	nnel):	9 m	
None/ineffective	Crops		Retired veg	getation	Stream	width	(water): 6 i	n		
One side/partial	Pasture		Native shru	b	Stream	depth:	0.30 m			
Complete	Exotic tree	S	Native tree	s	Surface	velocit	y: 0.25 m s	5-1		
Water quality										
Temperature:	14.6		°C		Conduc	tivity:	g	93.2	μ	5 cm⁻¹
Dissolved oxygen:	85.5		%		8.66		r	ng  -1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ed	0	ther	
Stream-bottom sul	ostrata									
Compaction (inorgan	ic substrata):				% surfic		rganic sub	stratu	m size	
Assorted sizes tightly	packed &/o	overla	apping		Substra		Dimensio	on	Percen	tage
Moderately packed w	-				Bedrock	(	-			
Mostly a loose assort	ment with litt	le over	lap		Boulder		>256mm		30	
No packing/loose asso	ortment easil	y move	ed		Cobble		>64-256mm	1	60	
Embeddedness:					Gravel		>2-64mm		7	
(% gravel-boulder particl	es covered by f	ine sedi	ment)		Sand		>0.06-2mm		2	
< <b>5%</b> 5-25	% 26-!	50%	51-75%	>75%	Silt		0.004-0.06n	nm	1	
	I				Clay		<0.004mm			
Organic material (%	6 cover)				Habita	t type	s sampled	d		
Large wood (>10cm d	iameter)				(% of eff	ort)	-			
< <b>5%</b> 5-25	% 26-	50%	51-75%	>75%	Stones:		70%			
Coarse detritus (small	wood, sticks	, leave	s etc., >1mm)		Wood:		%	Riff	les:	759
<b>&lt;5%</b> 5-25	% 26-	50%	51-75%	>75%	Macrop	hyte:	%	Run	IS:	209
Fine (<1mm) organic	deposits				Edges:		30%	Рос	ls:	59
<b>&lt;5%</b> 5-25	% 26-!	50%	51-75%	>75%	Numbe	r of inv	ertebrates	retur	ned:	
Instream plant cov	er (% stream	bed are	ea)		Koura: :	125	9	Shrimp	os: 0	
Filamentous algae & r	nats:				Crabs: 0	)	r	Musse	ls: 0	
<b>&lt;5%</b> 5-25	% 26-!	50%	51-75%	>75%	Other: (	)				
Macrophytes:	·				Mussel	type:				
<b>&lt;5%</b> 5-25	% 26-	50%	51-75%	>75%	Hyridell	а	0	Cucum	erunio	
Mosses/liverworts:	•									
	% 26-1	50%	51-75%	>75%						
<b>&lt;5%</b> 5-25	/0 20									

Site aurale in transitional state in the second state in	Wadeable Hard-Bo Qualitative Habitat As					a Shee	et														
Habitat parameter         U <thu< th="">         U         U</thu<>	Stream name: Waitea	ıriki S	trea	n					0,	Site n	umb	er: 1	430_	10							
Habitati parameter         U U U I IIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Sample number: 9				А	ssess	ior: J	osh S	mith					Date	: 4/0	3/20	15				
undigenerative zone width       buffer ≥10 	Habitat parameter		C	Optim	al			Sub	oopti	mal	Cate	gory		argir	nal				Роо	r	
Right bank:11       20       13       13       17       16       15       14       13       12       1       10       9       8       7       6       5       4       3       2       1         Mean: 13.5       .	vegetative zone		buffe	er >10	m			veget <10m	tation				and/	or sto	ck			Hum	nan ao	•	t
Number 13         <	Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
2. Vegetative protection <ul> <li>Bank surfaces &amp; immediate iparian covered mainly by native vegetation</li> <li>Disruption effection</li> <li>Disru</li></ul>	Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
immediate riparian protection       immediate riparian to escovered by any sector       covered mainly by riparian backbery, willow backbery, willow 	Mean: 13.5																				
Right bank:102019181716151413121110987654321Mean: 141109876543211Mean: 14600%0%654321Left bank:162019181716151413121110987654321Mean: 146-4321Mean: 146-4321Mean: 146-4321Mean: 14		•	imme zone nativ Trees shrul wood prese Vege	ediate s cove e veg s, und bs or r dy pla ent etative	ripari ered b etation er-sto non- nts	y n rey	•	cover nativ Disru Bank cover	red m e veg ption s may red by	ainly etatio evide be	n ent	•	cover of gra black & int speci Vege disru Bare cropp	red by asses/ berry roduces tatior ption soil/c ped ve	y mixt /shrut , willo ed obvio losely	os, ow ous	•	cove & sh Disrustres vege high Grass graz Sign	ered b irubs uption am ba etatio ss hea ed ifican	n of ank n very vily t stock	ĸ
$      Mean: 14 \\ 3. Bank stability \\ . Banks stable \\ . Frosion/bank failure absent/minimal \\ . <5\% of bank affected \\ . Signature affected \\ . Signature absent/minimal \\ . <5\% of bank affected \\ . Trosion/bank failure absent/minimal \\ . <5\% of bank affected \\ . Signature affected \\ . Signature absent/minimal \\ . <5\% of bank affected \\ . Signature absent/minimal \\ . <5\% of bank affected \\ . Many eroded areas \\ . Signature absent/minimal \\ . <5\% of bank affected \\ . Signature absent/minimal \\ . <5\% of bank affected \\ . Many eroded areas \\ . Many erode areas \\ . Many eroded areas \\ . Many eroded areas \\ . Many erode  areas \\ . Many erode areas \\ . Many erode areas \\ . Many erode$	Left bank:18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
3. Bank stability       •       Banks stable       •       Moderately stable       •       0	Right bank:10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Mean: 14																				
Right bank:122019181716151413121110987654321Mean: 144. Frequency of riffles $\cdot$ Riffles relatively frequent $\cdot$ </td <td>3. Bank stability</td> <td>•</td> <td>Erosi abse &lt;5%</td> <td>on/ba nt/mi of bar</td> <td>nk fai nimal</td> <td>lure</td> <td>•</td> <td>Infrease areas most 5-309</td> <td>quent s of er ly hea % of b</td> <td>, sma osion Iled o</td> <td>II</td> <td>•</td> <td>unsta 30-60 reach erosi High poter</td> <td>able 0% of n has a on erosio ntial c</td> <td>bank areas on</td> <td>of</td> <td>•</td> <td>Mar 60-1</td> <td>iy ero .00%</td> <td>of ban</td> <td>k</td>	3. Bank stability	•	Erosi abse <5%	on/ba nt/mi of bar	nk fai nimal	lure	•	Infrease areas most 5-309	quent s of er ly hea % of b	, sma osion Iled o	II	•	unsta 30-60 reach erosi High poter	able 0% of n has a on erosio ntial c	bank areas on	of	•	Mar 60-1	iy ero .00%	of ban	k
Mean: 14Image: Construct of the second	Left bank:16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
4. Frequency of riffles       • Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key       • Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15       • Occasional riffle or run       • Bottom contours provide some habitat       • Poor habitat         5. Channel alteration       20       19       18       17       16       15       14       13       12       11       10       9       8       7       6       5       4       3       2       1         5. Channel alteration       • Changes to channel/dredging absent/minimal pattern       • Some changes to channel/dredging absent/minimal       • Some changes to channel/dredging not present       • Channel channel/dredging not present       • Channel channel/dredging not present       • Channel channel/dredging not present       • Channel channel/dredging not present       • Channel channel/dred & disrupted       • Instream habitat altered/absent	Right bank:12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
$ \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Mean: 14																				
5. Channel       • Changes to channel/dredging absent/minmal       • Some changes to channel/dredging absent/minmal       • Channel changes/dredging extensive       • Banks shored with gabion/cement         5. Channel       • Channel       • Banks shored with changes/dredging extensive       • Banks shored with gabion/cement         • Stream with normal pattern       • Stream with normal not present       • Channel       • Banks shored with changes/dredging extensive       • Some changes to changes/dredging extensive       • Banks shored with gabion/cement         • How the state of the		•	frequ Dista riffle strea Varie	uent ince b s divic im wic	etwee led by lth=5-	7		riffle: Dista riffle:	s infre nce b s divic	quen etwee led by	en /	•	run Botto provi habit Dista riffles strea	om co de so at nce b s divic	ntour me etwee led by	s en /	-	wate riffle Poor Dista riffle	er, sh es r habi ance l es divi	allow tat betwe ided b	y
alteration       channel/dredging absent/minimal       channel/dredging absent/minimal       channel/dredging bettern       channel/dredging channel/dredging       channel/dredging extensive       gabion/cement         • Stream with normal pattern       • Stream with normal pattern       • Recent channel/dredging not present       • Embankments/shor ing structures present on both banks       • Instream habitat altered/absent	Score: 18	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
			chan abse Strea	nel/di nt/mi am wit	edgin nimal	-	•	chan Evide chan Rece chan	nel/di ence c nel/di nt nel/di	edgir f past edgir edgir	ng : ng		chan exter Emba ing st prese bank 40-80 Chan	ges/d nsive ankme tructu ent on s 0% of nelize	ents/s res both reach	hor	•	gabi >809 reac or d Instr	on/ce % of s h cha isrupt ream	ement tream nneliz ed habita	ed
	Score: 18	20	19	18	17	16	15	14	13	12	11	10	1		7	6	5	4	3	2	1

Habitat parameter			atego			Ha	bitat	para	mete	r			itego			Ha	bitat	para	mete	r
6. Sediment deposition	•	Little poin <20% affect sedir	Optim e/no is t bars 6 of bo cted by ment osition	lands prese ottom /	nt	•	form from or fin 20-50 affec	ation, grave e sed 0% of ted t depo	ase in most el, san iment botto ositior	ly d : m	•	Some new g fine s old & 50-80 affect Sedin at ob const bend	gravel edim new 0% of ted nent o struct rrictio	osition I, sand ent or bars botto depos cions,	d or າ m	•	Heav fine r Incre devel >80% chang frequ Pools abser sedin depo	mater ased opmo of bo ging iently almo nt due nent	bar ent ottom ost e to	
Score: 19 7. Velocity/depth regimes	20 •	regir Slow slow fast/	18 ocity/ nes pr /deep /shallo deep	esent , ow,		•	regin If fas	ity/de nes pr t/shal ng the	12 epth resent low is en sco		•	9 2 of 4 veloc regim If fast slow/ missi	ity/de nes pr t/shal ′shallo	esent low o ow are	r e	•	4 Domi veloc regin Usua	ity/de ne		
Score: 19 8. Abundance & diversity of habitat	20 •	favor inver color varie debr mats Snag logs/ bank prov fish o	s/ sub /under ss/cob ides al cover t not b	for te woody es, ro merg cut bles bunda	/ ot ed	15 • •	favou inver color Snags logs/ banks Fish o Mode of ha Can o	urable tebra iisatic s/ sub under s/cob cover erate bitat	te omergo cut bles comm variet types. t of sc	ed non y	10 • •	9 10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra iisatio cover )% sul v mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	5 • •	abser Subst or lac Stabl	urable tebra iisatic cover nt trate cking e hab ng or	e for te on rare c unstal itats limite	ble
Score: 18 9. Periphyton	•	evide held (mac woo	18 ohytor ent on substr crophy d etc., ments	hand rates tes,		•	visibl subst	rates		11	10 •	9 Perip <20% availa	cove	r of		•	& pro	olific 5 cove	2 er of ubstra	
Score: 10	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 143.5																				

Stream name: Waitav	wheta River				Assesso	r: Josh	Smith			
Site number: 1235_11	L	Samp	le number: 10		Date: 6/	′03/20	15 T	ime:	15:30	
GPS coordinates		Down	istream:		E 18454	80	Ν	V 584	9622	
		Upstr	eam:		E 18453	88	١	1 584	9622	
Channel & riparian	features				Instrea	m hye	draulic co	nditi	ions	
Canopy cover:					Estimate	d or me	asured reach	n aver	rage:	
Open	Partly s	haded	Very sł	naded						
Fencing:	Dominant	ripariar	vegetation:		Stream	width	(active cha	nnel)	: 6.0 m	
None/ineffective	Crops		Retired veg	etation	Stream	width	(water): 2.5	5 m		
One side/partial	Pasture		Native shru	b	Stream	depth:	0.10 m			
Complete	Exotic tree	S	Native trees	S	Surface	velocit	y: 0.15 m s	-1		
Water quality										
Temperature:	15.1		°C		Conduct	tivity:	1	.04.1	. μ	S cm <sup>-1</sup>
Dissolved oxygen:	58.2		%		5.87		r	ng l-1		
Turbidity:	Clear		Slightly turbid	Highly t	urbid	Stair	ied	C	Other	
Stream-bottom sub	ostrata									
Compaction (inorgani	ic substrata):				% surfic compos		rganic subs	strati	um size	
Assorted sizes tightly	packed &/or	overla	pping		Substrat	tum	Dimensio	n	Percer	ntage
Moderately packed w	ith some over	rlappin	g		Bedrock		-			
Mostly a loose assortr	nent with litt	le over	lap		Boulder		>256mm		10	
No packing/loose asso	ortment easily	y move	d		Cobble		>64-256mm		72	
Embeddedness:					Gravel		>2-64mm		15	
(% gravel-boulder particle	es covered by fi	ine sedii	ment)		Sand		>0.06-2mm		2	
(// Braver pounder barner	,									
<5% 5-25°		50%	51-75%	>75%	Silt		0.004-0.06m	ım	1	
1	1	50%	51-75%	>75%			0.004-0.06m <0.004mm	ım	1	
< <b>5%</b> 5-25	% 26-5	50%	51-75%	>75%	Silt Clay	t type			1	
< <b>5%</b> 5-25	% 26-5 6 cover)	50%	51-75%	>75%	Silt Clay		<0.004mm		1	
<5% 5-25 Organic material (%	% 26-5		51-75%	>75% >75%	Silt Clay Habita		<0.004mm		1	
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25	% 26-5 6 <b>cover)</b> iameter) % 26-5	50%	51-75%		Silt Clay Habita (% of effo		<0.004mm	1	1 fles:	20%
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25	% 26-5 6 <b>cover)</b> iameter) % 26-5 wood, sticks,	50% , leaves	51-75%		Silt Clay Habita (% of effo Stones:	ort)	<0.004mm s sampled 70%	<b>I</b> Rif		
<5%	% 26-5 6 <b>cover)</b> iameter) % 26-5 wood, sticks, % 26-5	50% , leaves	51-75% etc.,. >1mm)	>75%	Silt Clay <b>Habita</b> (% of effo Stones: Wood:	ort)	<0.004mm s samplec 70% %	<b>i</b> Rif Ru	fles:	75%
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25 Coarse detritus (small	% 26-5 <b>6 cover)</b> iameter) % 26-5 wood, sticks, % 26-5 deposits	50% , leaves 50%	51-75% etc.,. >1mm)	>75%	Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges:	brt) hyte:	<0.004mm s samplec 70% % %	<b>I</b> Rif Ru Po	fles: ns: ols:	209 759 59
<5%	%     26-5       6 cover)       iameter)       %     26-5       wood, sticks,       %     26-5       deposits       %     26-5	50% , leaves 50% 50%	51-75% etc.,. >1mm) 51-75% 51-75%	>75% >75%	Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges:	hyte:	<0.004mm s samplec 70% % 30% ertebrates	Rif Ru Po retu	fles: ns: ols:	75%
<5%	%     26-5       6 cover)	50% , leaves 50% 50%	51-75% etc.,. >1mm) 51-75% 51-75%	>75% >75%	Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number	hyte: r of inv 25	<0.004mm s samplec 70% % 30% ertebrates S	Rif Ru Po retu	fles: ns: ols: rned:	75%
<5%	%         26-5           6 cover)	50% , leaves 50% 50% bed are	51-75% etc.,. >1mm) 51-75% 51-75%	>75% >75%	Silt Clay <b>Habita</b> (% of effo Stones: Wood: Macrop Edges: Number Koura: 2	hyte: r of inv	<0.004mm s samplec 70% % 30% ertebrates S	Rif Ru Po retu	fles: ns: ols: rned: nps: 0	75%
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic of <5% 5-25% Instream plant cove Filamentous algae & r <5% 5-25%	%         26-5           6 cover)	50% , leaves 50% 50% bed are	51-75% etc.,. >1mm) 51-75% 51-75%	>75% >75% >75%	Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: 2 Crabs: 0	hyte: r of inv 25	<0.004mm s samplec 70% % 30% ertebrates S	Rif Ru Po retu	fles: ns: ols: rned: nps: 0	75%
<5% 5-25 Organic material (% Large wood (>10cm d <5% 5-25 Coarse detritus (small <5% 5-25 Fine (<1mm) organic of <5% 5-25 Instream plant cover Filamentous algae & r	%     26-5       6 cover)	50% , leaves 50% 50% bed are	51-75% etc.,. >1mm) 51-75% 51-75%	>75% >75% >75%	Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: 2 Crabs: 0 Other: 0	hyte: r of inv 25	<0.004mm s samplec 70% % 30% ertebrates S	Rif Ru Po retu	fles: ns: ols: rned: nps: 0	75%
<5% 5-25% Organic material (% Large wood (>10cm d <5% 5-25% Coarse detritus (small <5% 5-25% Fine (<1mm) organic o <5% 5-25% Instream plant cove Filamentous algae & r <5% 5-25% Macrophytes:	%     26-5       6 cover)	50% , leaves 50% 50% bed are	51-75% etc.,. >1mm) 51-75% 51-75% ea) 51-75%	>75% >75% >75%	Silt Clay <b>Habita</b> (% of effe Stones: Wood: Macrop Edges: Number Koura: 2 Crabs: 0 Other: 0	hyte: r of inv 25	<0.004mm s samplec 70% % 30% ertebrates S	Rif Ru Po retu	fles: ns: ols: rned: nps: 0	75%

Qualitative Habitat Ass	sessr	nent		<b>ms</b> Data	Shee	et														
Stream name: Waitaw	heta	a Rive	r					0	Site n	umb	er: 1	235_3	11							
Sample number: 10	1			A	ssess	or: J	osh S	mith					Date	: 6/0	3/20	15				
Habitat parameter										Cate	gory									
1. Riparian vegetative zone width	•	Bank	tation n nuou	ı buffe	er	•	Bank veget <10m	tation	buffe		•	Pathy	or sto	oresei ck		•		Poor aks fre nan ac ous	quent	-
Left bank:4	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: 7																				
2. Vegetative protection	•	imme zone nativ Trees shrut wood prese Vege	ediate s cove e veg s, und os or i ly pla ent tative	nts	ian y n orey	•	cover nativ Disru Bank	surfa red m e veg ption s may red by try	ainly etatio evide be	n ent	•	Bank cover of gra black & intr speci Vege disru Bare cropp comr	red by asses/ berry roduc es tation ption soil/c ped ve	y mixt /shruk , willo ed obvio losely	os, ow ous	•	cove & sh Disr strea high Gras graz Sign	s hea	y gras of nk very vily	¢
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:13	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	•	Erosi failur	e nt/mi of bar	ank nimal		• • •	Infre areas most	eratel quent s of er ly hea % of b ed	, sma osion aled o	II	•	Mode unsta 30-60 reach erosid High poter flood	able 0% of n has a on erosic ntial d	bank areas on	of	•	Mar 60-1	table iy eroo .00% c erosio	of ban	k
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:18	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	•	frequ Dista riffle strea	ient nce b s divio m wio	tively etwee led by dth=5- habita	en / -7	•	riffle: Dista riffle:	rrenco s infre nce b s divic m wic	equen etwee led by	en /	•	Occas run Botto provi habit Dista riffles strea 25	om co de so at nce b s divic	ntour me etwee led by	s en /	•	wate riffle Poo Dist riffle	erally er, sha es r habit ance b es divid am wi	at etwee ded by	y
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	•	abse Strea	nel/di nt/mi	redgir nimal th	ng	•	chan Evide chan Rece chan	e char nel/di ence c nel/di nt nel/di oresen	redgir of past redgir redgir	ng t ng	•	Chan chang exter Emba ing st prese banks 40-80 chang disru	ges/d nsive ankme ructu ent on s 0% of nelize	ents/s res i both reach	hor	•	gabi >80 reac or d Insti	ks sho on/ce % of st h chai isrupto ream h red/at	ment ream nneliz ed nabita	ed
Score:17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	-		atego ptim			Ha	bitat	parai	mete	r			itego ptim			На	ıbitat	para	mete	er
6. Sediment deposition	•	point <20% affec sedin	bars of bo ted by		nt	•	form from	ted t depo	most I, san iment botto	ly d t m	•	Some new § fine s old & 50-80 affect Sedin at ob const bend	gravel edime new 0% of ted nent o struct rictio	l, sand ent of bars botto depos	d or n m	•	fine f Incre deve >80% chan frequ Pool: abse sedir	mater ased lopm of b ging uently s almont du	bar ent ottom ost e to	
Score: 17 7. Velocity/depth regimes	20 •	regin Slow, slow,	nes pr /deep /shallo shallo	ow,		•	regin If fas	ity/de nes pr t/shal ng the	esent low is			9 2 of 4 veloc regim If fast slow/ missi	ity/de ies pr :/shal /shallo	esent low o ow ar	r e	•	veloo regin	city/d ne	2 d by 1 epth ep/sl	
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	•	favou inver color varie debri mats Snag logs/ bank provi fish c	ty of v s, riff s/ sub under s/cob des a over not b	for te on & v wood les, ro omerg cut	y oot ed	•	favou inver color Snags logs/ bank Fish o Mode of ha Can o	under s/cob	for te merg cut bles comn variet types t of so	ed non sy	•	10-30 favou inver colon Fish c 60-90 easily foot Wood or ma smot sedin	irable tebra isatio over 0% sul mov dy del ay be hered	for te n patch bstrat ed by bris ra	y e	•	favor inver color Fish abse Subs or la Stabl lacki	urable tebra nisatio cover nt trate cking e hat	ite on rare o unsta bitats limite	ble
Score:18 9. Periphyton	20 • •	evide held Stabl	stone e sub ces ro	hand	!	15 • •	visibl Stabl	13 hytor e on s e subs hytor uch	tones strate		10 •	9 Perip <20% availa	cove	r of		•	& pro	olific 6 cove	2 n obvi er of substr	
Score: 7	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 120																				<u> </u>

## Appendix B Fish surveys

Fish collection form	n – Wa	Ideable	strear	ns/rivers														
Team members: Josh Smith (NIWA), Mike Ma	artin (NIV	/A),	GPS (d/s):	E1818698	N5	5838814	Site	: Man	igakahika	Stream					Date:	02/03/2	015	
Elizabeth Graham (NIWA), Kathryn Reeve (NIWA)			GPS (u/s):	E1818618	N5	5838767	No	ot fished		d none ected	-	ed 10 sub- eaches	Fished 5 sub-reac			<5 sub- ches	FLAG fished/ fishe	/not
	l shock (min):	35	Fishing time:	Finish	14:30 16:30	Sample distance	(m):	50	Wette (m):	d width	A B	0.8 C 2.0 D	1.9			G 2.0 H 1.7	7 J	1.5
Sampling gear: Spotli	ght	EFM			ength (m) /lesh (mm)		Wat visib		Good	Avera	ge	Poor	Water temp. (°C	C): 17	7.5	Conduc (µS):	tivity 1	197.8
EFM anode: Big Small	EFM	volts (x100)	): 3			lse rate (Hz	or pps):	60	EFM p	ulse widt	th (ms)			Spotlight	•			
Species	А	В	c	D	Sub-re	each tally F	G	Н			J	Total count	Sample count		ength ( lin.	Max.	FLAC	G
Common bully	1		1		4		1					7			21	59		
Banded kokopu	1		6	1	11	1		6	2		2	30			48	174		
Shortfin eel		1	2	2	1	1	2	3	3		3	18			125	422		
Longfin eel											1	1			795	795		
Elver	1		1			1						3			100	100		
Unidentified eel					2				1			3			175	200	_	
		_																
FLAG Comment Water very low							FLA	G Con	nment									
water very low																		

	collection form	n – W	adeable	stream	s/rivers													
Team m Josh Sm	iembers: nith (NIWA), Mike Mi	artin (NI	WA),	GPS (d/s):	E1831974	N5	803819	Site:	Wait	toa Strear	n					Date:	05/03/2	015
	h Graham (NIWA), n Van Ravenhorst (N	NIWA)		GPS (u/s):	E1831878	N5	803808	No	ot fished		d none ected		ed 10 sub- eaches		ed 5-9 eaches		l <5 sub- iches	FLAG for fished/not fished
Fish sample i		l shock (min):	74	Fishing time:	Start Finish	13:00 15:00	Sample distance (	m): 1	50	Wettee (m):	d width	AB	0.9 C 1.2 D			1.0 1.5	G 2.1 H 1.8	3 J
Samplin		ght	EFM	S		ength (m) lesh (mm)		Wate visib		Good	Avera	ge	Poor	Water temp.		16.7	Conduc (µS):	tivity 119.9
EFM and	ode: Big Small	EFM	l volts (x100)	): 3			se rate (Hz o	r pps):	60	EFM p	ulse wid	th (ms)	: 2			ght (watts	s):	
Species		А	В	C	D	Sub-rea	ach tally F	G	н		I	J	Total count	San cou		Length Min.	(mm) Max.	FLAG
Cran's b		8	6	16	4	2	9		14	8			67			20	78	
Shortfin	eel	7	23	11	8	6	4		11	10			80			95 75	450	
Elver Koura		2	3	5	1	5	4		1	2			22 10			75	250	
Roula		0	2						2	4			10					
				-														
FLAG	Comment							FLA		nment								
TLAG	Small anode used	for pock	et water in s	sections A	and B, other	sub-reache	s used big			Intent								
	Zero paratya																	
			1000/															
G	Subreach G misse Subreach J also m				over													
J	Subreach J also m	iisseu al	16 10 90% W	atercress	over													

Fish c	ollection form	n – Wa	deable	streams	s/rivers											
Team me Josh Smi	embers: ith (NIWA), Mike Ma	artin (NIW	'A),	GPS (d/s):	E1836783	N5	809932	Site:	Mang	gapapa Stre	am			Date:	05/03/201	15
	n Graham (NIWA), Van Ravenhorst (N	IWA)		GPS (u/s):	E1836750	N5	809802	No	ot fished	Fished no collecte		shed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample ic		l shock (min):	76	Fishing time:	Start Finish	09:00 12:00	Sample distance	(m):	50	Wetted w (m):	idth A B	2.2 C 4.4 D	3.7 F		G 4.6 H 3.8	l 3.1 J
Sampling		ght	EFM	Se		ength (m) lesh (mm)		Wate visib		Good A	Verage	Poor	Water temp. (°C):	16.1	Conductiv (µS):	<sup>/ity</sup> 116.7
EFM ano	de: Big Small	EFM	olts (x100)	: 3			se rate (Hz	or pps):	60	EFM pulse	e width (m	-	-	ght (watts	-	-
Species		А	В	С	D	Sub-re	ach tally F	G	Н		J	Total count	Sample count	Length ( Min.	mm) Max.	FLAG
Cran's bu	ılly	12	7	18	11	12	22	9	12	1		104		20	68	
Shortfin e	el	1		6	3	3	5	11	2	3	2	36		84	650	
Longfin e	el	1	1	2			1					5		101	700	
Elver			1		2	2	1			1		7		100	150	
Unidentifi	ied eel	1										1				
Koura		1	2	2	1	1	2	1		1		11				
FLAG	Comment							FLA	G Com	iment						
	Water low and clear															
	Lots of Hyridella she	lls found														
	2 live mussels found	in reach H														

Fish c	ollectio	n forn	n – Wa	adeable	stream	s/rivers											
Team me Josh Sm	embers: iith (NIWA),	Mike Ma	artin (NIV	VA),	GPS (d/s):	E1817745	N5	815748	Site	: Wai	takaruru Stre	eam			Date:	02/03/20	15
	n Graham ( Reeve (NIV				GPS (u/s):	E1817903	N5	815670	N	ot fished	Fished n collecte		Fished 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample i	d: Y		shock (min):	43	Fishing time:	Start Finish	10:45 12:40	Sample distance	(m):	150	Wetted v (m):		4 C 3 C	) F		G H	l J
Sampling	g gear:	Spotli	ght	EFM	Se		ength (m) lesh (mm)		Wat visit	ter bility:	Good	Average	Poor	Water temp. (°C):	17.6	Conducti (µS):	<sup>vity</sup> 136.1
EFM and	ode:	Big Small	EFM	volts (x100)	: 3			se rate (Hz	or pps):	60	EFM puls	e width			ight (watts	,	-
Species			А	В	С	D	Sub-re	ach tally F	G	Н	1	J	Total count	Sample count	Length ( Min.	(mm) Max.	FLAG
Cran's bu	ully		3			3	11	11	12	11	5	7	63		18	55	
Shortfin	eel		4	2	3	3	1	2	4	3	5	3	30		87	718	
Elver					1				1	2			4		100	100	
Unidentif	fied eel			1	1	1				1			4		200	450	
Torrentfi	sh		2				1						3		83	128	
Koura						4			4	2	3	1	14				
FLAG	Comment								FLA	G Con	nment						
	Less in-stre	am scrub	– making	g fishing faste	er												

Team m	embers: hith (NIWA)	Miko M	artin (NIIV		GPS (d/s):	E1831211	N5	815768	Site	: Piak	onui Strea	m			Date:	04/03/20	)15
Elizabet	h Graham ( NVan Rave	(NIWA),	,	vA),	GPS (u/s):	E1831210	N5	809980	N	ot fished	Fished colled		Fished 10 sub- reaches	Fished 5-9 sub-reaches		l <5 sub- iches	FLAG for fished/not fished
Fish sample i	id: Y		l shock (min):	52	Fishing time:	Start Finish	15:30 18:15	Sample distance	(m):	50	Wetted (m):			C 2.1 E D 2.1 F		G 1.4 H 1.6	J 3.2
Samplin	g gear:	Spotli	ght	EFM	S		ength (m) esh (mm)		Wat visit	er pility:	Good	Average	Poor	Water temp. (°C):	13.1	Conduct (µS):	<sup>ivity</sup> 90.1
EFM an	ode:	Big Small	EFM	volts (x100	)): 3			se rate (Hz	or pps):	60	EFM pu	lse width	(ms): 2	Spot	light (watts		
Species			А	В	C	D	Sub-rea	ach tally F	G	н	1	J	Total count	Sample count	Length Min.	(mm) Max.	FLAG
Commo	n bully				1	3	1				6	10	21		30	79	
Banded	kokopu		2	2								1	5		55	172	
Shortfin	eel		2	1	2			1	3	1	2	1	13		97	163	
Longfin	eel					1	1	1		1			4		438	640	
Elver				1		1		1				3	6		100	100	
Koura			12	7	4	16	8	11	11	7	7		83				
FLAG	Comment								FLA	G Com	iment			1	I		
	Low and cl High sedim																
	. ign seam																

Fish collect	ion forn	n – Wa	adeable	streams	s/rivers											
Team members: Josh Smith (NIW/	A), Kathryn	ı Reeve (	NIWA)	GPS (d/s):	E1841027	N5	867879	Site:	Paial	karahi Strea	ım			Date:	06/03/2	015
Elizabeth Graham Bastiaan Van Rav	. ,	NWA)		GPS (u/s):	E1841098	N5	867799	No	ot fished	Fished n collecte		hed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id: Y		l shock (min):	48	Fishing time:	Start Finish	11:00 13:10	Sample distance	(m): 1	50	Wetted w (m):	/idth <u>A</u> B	2.2 C 2.8 D			G 2.6 H 2.4	J 2.4
Sampling gear:	Spotli	ght	EFM	Se		ength (m) lesh (mm)		Wate visib		Good	Average	Poor	Water temp. (°C):	16.4	Conduc (µS):	tivity 118.7
EFM anode:	Big Small	EFM	volts (x100	): 4		-	se rate (Hz o	or pps):	60	EFM puls	e width (m			ight (watts		
Species		A	В	С	D	Sub-rea	ach tally F	G	Н		J	Total count	Sample count	Length ( Min.	Max.	FLAG
Banded kokopu				1								1		51	51	
Shortfin eel		1		2			1		2			6		108	170	
Longfin eel			1	1		3	2		2		1	10		162	650	
Unidentified eel			1				1	1	1			4		100	200	
Cran's bully		3	2	7	4	6	1	2	6	2		33		20	75	
Torrentfish											1	1		114	114	
Inanga								2				2		85	85	
Brown trout						1				1		2		260	280	
Rainbow trout											2	2		105	120	
Koura				3	6	12	7	2	2	2		34		1		
Paratya									3			3				
									1					1		
									1					1		
FLAG Comme	nt							FLA	G Com	ment						

Fish o	collection for	m – Wa	adeable	stream	s/rivers												
	iembers: nith (NIWA), Kathry	n Reeve (	(NIWA),	GPS (d/s):	E1848393	N5	823235	Site	Kare	engorengo	Stream				Date:	03/03/20	15
	h Graham (NIWA), n Van Ravenhorst (			GPS (u/s):	E1848423	N5	823089	N	ot fished	Fished collec		Fished reac		Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample		al shock e (min):		Fishing time:	Finish 17:00		Sample distance	(m):	50	Wetted (m):			1.7 C 1.7 D	2.3 F		G 3.1 H 2.8	l 2.9 J
Samplin	EM opada: Big EEM valta (v1		EFM	S	Seine Length (m) Mesh (mm)		Wat visib	er oility:	Good	Average	F	Poor	Water temp. (°C):	15.6	Conducti (µS):	<sup>vity</sup> 146.1	
EFM an	Decies			: 3			se rate (Hz	or pps):	60	EFM pul	se width		2		ight (watts		<u> </u>
Species	i	А	В	С	D	Sub-re	ach tally F	G	н	1	J		otal ount	Sample count	Length Min.	(mm) Max.	FLAG
Commo	nmon bully 2				1	2	3	4	2	1	2		17		30	74	
Shortfin	eel	15	10	10	12	3	14	7	9	11	7		98		75	675	
Inanga								1					1		93	93	
Smelt		9	1			12		2					24		57	93	
Trout (u	nidentified)			1	1						2		4		40	150	
Koura		4	5	6	1	3	4	6	1	1			31				
																	<u> </u>
																	<u> </u>
FLAG	Comment							FLA	G Con	nment							1
LAU		ass macror	hytes than la	oct voor				- LA									
	Water level low – less macrophytes than last year Some deeper and weed-covered sections missed							_									
	Some deeper and weed-covered sections missed																

Fish collection	on forr	n – Wa	adeable	streams	s/rivers											
Team members: Josh Smith (NIWA	), Kathryn	Reeve	(NIWA),	GPS (d/s):	E1851649	N5	819801	Site:	: Wair	ere Stream				Date:	03/03/2	015
Elizabeth Graham Bastiaan Van Rave		NIWA)		(u/s):	E1851719	N5	803808	No	ot fished	Fished r collect		rished 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish Y sample id:		l shock (min):	92	Fishing time:	Start Finish	09:30 13:15	Sample distance	(m):	50	Wetted v (m):	width <u>A</u>				G 7.2 H 4.7	′J 5.3
Sampling gear:	Mesh (nin)			Water Good Average Poor visibility:		Water temp. (°C):	15.5	Conduc (µS):	tivity 66.5							
EFM anode:	Small				····(···(···)									light (watts		
Species		А	В	С	D	E	ach tally F	G	н		J	Total count	Sample count	Length Min.	Max.	FLAG
Common bully		12	18	24	12	18	29	40	15	7	33	208		21	68	
Shortfin eel		30	6	13	9	10	11	28	23	7	11	148		86	530	
Longfin eel					1							1		930	930	
Elver		1		4	8			9	3	3	6	34				
Unidentified eel			6			2	2			1	3	14		150	350	
Torrentfish											2	2		80	93	
Rainbow trout						1					2	3		80	108	
Brown trout			1			1		2			1	5		95	350	
Koura		3	2	3	2	2		1	1		1	15				
Paratya		1	1	3			1					6				
FLAG Commen	t							FLA	G Com	ment						

Fish collection form – Wad	deable	streams	/rivers											
Team members: Josh Smith (NIWA), Mike Martin (NIWA	A),	GPS (d/s):	E1852566	N5	818150	Site:	Waite	eariki Strear	n			Date:	04/03/20	15
Elizabeth Graham (NIWA), Bastiaan Van Ravenhorst (NIWA)		GPS (u/s):	E1852697	N5	818212	No	ot fished	Fished n collecte		shed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish Y Total shock time (min):	89	Fishing time:	Start Finish	09:45 Sample 14:17 distance (m):		(m):	50 Wetted width (m):		ridth <u>A</u> B	4.4 C 5.6 D	6.1 F		G 8.8 H 9.1	l 5.7 J 6.2
Sampling gear: Spotlight	EFM	Sei		ength (m) esh (mm)			er ility:	Good	Average	Poor	Water temp. (°C):	14.5	Conduct (µS):	ivity 88.3
EFM anode: Big EFM vo	: 4	4 EFM pulse rate (Hz or pps) Sub-reach tally									ght (watts			
Species	cies A B C						Н		J	Total count	Sample count	Length ( Min.	(mm) Max.	FLAG
Shortfin eel 10	16	2	8	7		2	4		2	51		95	430	
Longfin eel 1				1	3	2	2	6		15		150	850	
Cran's bully 5	11	5	9	12	13	4	5		23	87		20	75	
Rainbow trout						1				1		120	120	
Brown trout						1				1		400	400	
Torrentfish						2				2		81	116	
Koura 18	17	2	7	13	7	8	26	20	7	125				
FLAG Comment				I		FLA	G Com	ment						
Stream low and clear														
Subreach A-D Elizabeth fishing,	0													
Sections G and H water disappe	Sections G and H water disappearing under rocks – fish habitat r													

Fish collection	n form	n – Wa	adeable	streams	/rivers											
Team members: Josh Smith (NIWA),	Kathryn	Reeve (	(NIWA),	GPS (d/s):	E1845480	N5	849662	Site:	Wait	awheta Rive	er			Date:	06/03/20	)15
Elizabeth Graham (N Bastiaan Van Raven		liwa)		GPS (u/s):	E1845388	N5	849622	No	ot fished	Fished n collecte		shed 10 sub- reaches	Fished 5-9 sub-reaches		<5 sub- ches	FLAG for fished/not fished
Fish sample id: Y		shock (min):	49	Fishing time:	Start Finish	15:00 17:00	Sample distance	(m):	50	Wetted w (m):	ridth A B	2.8 C 3.1 D	2.2 F		G 3.2 H 4.0	J 2.8
Sampling gear:	Spotlig	ght	EFM	Se		ength (m) lesh (mm)		Wate visib		Good	Average	Poor	Water temp. (°C):	15.1	Conduct (µS):	ivity 104.1
EFM anode:	Small EFM Volts			: 4			se rate (Hz o	or pps):	60	EFM puls	e width (n			ight (watts		
Species	ties A mon bully 4 tfin eel 3 entified eel 3				D	E	ach tally F	G	н	<u> </u>	J	Total count	Sample count	Length ( Min.	Max.	FLAG
Common bully	nmon bully 4			9	13	6	3	5	6	4	3		53	30	80	
Shortfin eel				4	2	-		4	1	1	-		12	132	351	
Longfin eel		3		2	1	3		2	1	3	2		17	205	710	
Unidentified eel				1	2	1			2	2			8	100	200	
Brown trout				-		1					<u> </u>		1	160	160	
Koura		2	2	3	6	2	1	5	1	2	1		25			
																+
FLAG Comment							<u> </u>	FLA	G Com	iment			- 1	1		

## Appendix C Macrophytes and periphyton

Periphyton Assessmer	ht						
Stream: Mangakahika Strea	m	Date: 02/	03/2015				
Sample Number: 1		Located n	number:				
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	20	20	20	20	20	20
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
Shint theky	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte	recording she	et								
Stream: Manga	kahika Stream			Located number:		Sample	e Numbe	r: 1		Date: 02/03/2015
						Vegetation co	over (% w	etted area)		
	Wetted width	Channel width			Sub	merged plants				Emergent plants
Transect	(m)	(m)	Total		Sur	face-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	2.0	4.5	0	0					0	
2	2.5	4.5	0	0					0	
3	1.9	5.0	0	0					0	
4	1.2	6.0	0	0					0	
5	1.0	5.0	0	0					0	

Periphyton Assessmer	nt						
Stream: Waitoa Stream		Date: 05/	03/2015				
Sample Number: 2		Located r	number:				
Thickness category	Colour category	A	В	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	5	5	5	0	5	4
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
Shin thek)	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte	Macrophyte recording sheet												
Stream: Waitoa	a Stream		Located nu	mber:		Sample Number: 2			Date: 05/03/2	2015			
						Vegetation co	over (% w	etted area)	_				
	Wetted width	Channel width			Sub	merged plants	-			Emergent plants			
Transect	(m)	(m)	Total		Su	rface-reaching	Bel	ow surface					
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species			
1	1.0	4.5	20	0					20	Gr (5) Na (15)			
2	1.3	4.5	5	0					5	Gr			
3	0.8	3.0	2	0					2	Gr			
4	1.4	4.0	100	0					100	Na			
5	1.1	4.0	20	0					20	Na			

Periphyton Assessmer	ht						
Stream: Mangapapa Stream		Date: 05,	/03/2015				
Sample Number: 3		Located r	number:				
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	10	5	5	5	5	6
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
Sinn thek)	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)				15	5	4
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)			5	5	10	4
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte	recording she	et								
Stream: Manga	ipapa Stream		Located nu	mber:		Sample Number: 3			Date: 05/03/2	2015
						Vegetation co	over (% we	etted area)	•	
	Wetted width	Channel width			Sub	merged plants				Emergent plants
Transect	(m)	(m)	Total		Su	rface-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	4.1	4.8	0	0					0	
2	2.9	4.7	9	5			5	Ec (3) Nh (2)	4	Lp (3) Le (1)
3	3.2	4.5	5	0					5	Gr
4	3.9	4.5	6	0					6	Gr (3) Le (3)
5	3.0	4.5	2	0					2	Gr

Periphyton Assessmer	nt						
Stream: Waitakaruru Strear	n	Date: 02/	03/2015				
Sample Number: 4		Located n	number:				
Thickness category	Colour category	A	в	с	D	E	Mean cover
Thin (<0.5mm) Mat/Film	NA	20	10	10	10	10	12
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0
Shin they	Light brown (% cover)						0
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)			10	30	35	15
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte	recording she	et								
Stream: Waitak	aruru Stream		Located nu	mber:		Sample Number: 4			Date: 02/03/2	2015
						Vegetation co	over (% we	etted area)		
	Wetted width	Channel width			Sub	omerged plants				Emergent plants
Transect	(m)	(m)	Total		Su	rface-reaching	Bel	ow surface		
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species
1	3.1	4.5	40	30	30	Lm (10) Pk (20)			10	Ph
2	2.9	4.5	90	80	80	Lm (10) Pk (70)			10	Ph
3	3.1	5.0	10	10	10	Lm			0	
4	2.5	4.0	20	20	20	Lm (5) Pk (15)			0	
5	3.5	4.5	50	50	50	Lm (10) Pk (40)			0	

Periphyton Assessme	nt								
Stream: Piakonui Stream		Date: 04/03/2015							
Sample Number: 5		Located number:							
Thickness category	Colour category	A	В	с	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA						0		
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0		
Shin they	Light brown (% cover)						0		
	Black/dark brown (% cover)						0		
Thick (>3mm) mat/film	Green/light brown (% cover)						0		
	Black/dark brown (% cover)						0		
Filaments short (<2cm)	Green (% cover)						0		
	Brown/Reddish (% cover)						0		
Filaments long (>2cm)	Green (% cover)						0		
	Brown/Reddish (% cover)						0		
Submerged bryophytes	NA						0		
Iron Bacteria growths	NA						0		

Macrophyte	recording she	et										
Stream: Piakon	ui Stream		Located number: 5 Sample Number: 5					Date: 04/03/2015				
				Vegetation cover (% wetted area)								
Wetted width		Channel width		Submerged plants						Emergent plants		
Transect	(m) (m)	Total	Total submerged	Su	rface-reaching	Bel	ow surface					
				cover	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	2.7	3.5	0	0					0			
2	2.2	3.5	0	0					0			
3	1.9	3.5	0	0					0			
4	1.8	3.5	0	0					0			
5	2.1	3.7	0	0					0			

Periphyton Assessmer	t									
Stream: Paiakarahi Stream		Date: 06/03/2015								
Sample Number: 6		Located number:								
Thickness category	Colour category	A	в	с	D	Mean cover				
Thin (<0.5mm) Mat/Film	NA	70	70	5		5	30			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
Simil thek)	Light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)		5	80	70	60	43			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

Macrophyte	recording she	et										
Stream: Paiaka	rahi Stream		Located number: Sample Number: 6					Date: 06/03/2015				
				Vegetation cover (% wetted area)								
Wetted width	Channel width		Submerged plants						Emergent plants			
Transect	(m) (m)		Total		Su	face-reaching	Bel	ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	3.8	6.5	0	0					0	0		
2	2.6	6.0	0	0					0	0		
3	3.9	6.5	0	0					0	0		
4	4.0	7.0	0	0					0	0		
5	3.8	7.0	0	0					0	0		

Periphyton Assessmer	nt									
Stream: Karengorengo Strea	am	Date: 03/03/2015								
Sample Number: 7		Located number:								
Thickness category	Colour category	А	В	С	D	Mean cover				
Thin (<0.5mm) Mat/Film	NA	10			10		4			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
Shin they	Light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

Macrophyte	recording she	et										
Stream: Kareng	orengo Stream		Located number: Sample Number: 7				,		Date: 03/03/2	2015		
				Vegetation cover (% wetted area)								
	Wetted width Channel width				Sub	merged plants				Emergent plants		
Transect	(m)	(m)	Total		Su	Surface-reaching		ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	1.9	5	50	5			5	Nh	45	An (30) Ph (15)		
2	2.1	5.2	50	0					50	An (45) Ph (5)		
3	2.3	5.5	25	0					25	An (10) Gr (5) Ph (10)		
4	2.1	5.5	55	0					55	An (40) Ph (15)		
5	1.8	5.0	45	5			5	Nh	40	An (30) Ph (10)		

Periphyton Assessme	nt									
Stream: Wairere Stream		Date: 03/03/2015								
Sample Number: 8		Located r	number:							
Thickness category	Colour category	A	В	с	D	E	Mean cover			
Thin (<0.5mm) Mat/Film	NA	5	5	15	5	10	8			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
Shin they	Light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)	20	35	5	30	20	22			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

Macrophyte	recording she	et										
Stream: Wairer	e Stream		Located number:			Sample Number: 8			Date: 03/03/2015			
				Vegetation cover (% wetted area)								
Wetted width C		Channel width			Sub	merged plants			Emergent plants			
Transect	(m) (m)		Total		Su	rface-reaching	Bel	ow surface				
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	6.8	9.0	0	0					0			
2	5.8	8.5	0	0					0			
3	4.3	7.5	0	0					0			
4	6.2	7.5	0	0					0			
5	6.5	8.5	0	0					0			

Periphyton Assessmer	nt									
Stream: Waiteariki Stream		Date: 04/03/2015								
Sample Number: 9		Located number:								
Thickness category	Colour category	A	в	с	D	Mean cover				
Thin (<0.5mm) Mat/Film	NA	10	5	10	10	10	9			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
Shini theky	Light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

Macrophyte	recording she	et										
Stream: Waitea	ariki Stream		Located number: 9 Sample Number: 9					Date: 04/03/2	2015			
				Vegetation cover (% wetted area)								
	Wetted width	Channel width		Submerged plants						Emergent plants		
Transect	(m)	(m)	Total		Su	face-reaching	ce-reaching Below surface					
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	5.5	8.0	0	0					0			
2	5.8	8.5	0	0					0			
3	6.1	8.5	0	0					0			
4	6.6	8.5	0	0					0			
5	6.4	9.0	0	0					0			

Periphyton Assessmer	nt									
Stream: Waitawheta River		Date: 06/03/2015								
Sample Number: 10		Located number:								
Thickness category	Colour category	A	в	с	D	DE				
Thin (<0.5mm) Mat/Film	NA	10	10	10	10	10	10			
Medium mat/film (0.5- 3mm thick)	Green (% cover)						0			
Smitt thek)	Light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Thick (>3mm) mat/film	Green/light brown (% cover)						0			
	Black/dark brown (% cover)						0			
Filaments short (<2cm)	Green (% cover)						0			
	Brown/Reddish (% cover)						0			
Filaments long (>2cm)	Green (% cover)	40	5			5	10			
	Brown/Reddish (% cover)						0			
Submerged bryophytes	NA						0			
Iron Bacteria growths	NA						0			

Macrophyte	recording she	et										
Stream: Waitav	wheta River		Located number: Sample Number				0		Date: 06/03/2	2015		
				Vegetation cover (% wetted area)								
Wetted width		Channel width		Submerged plants						Emergent plants		
Transect	nsect (m) (m)		Total cover	Total submargad	Su	rface-reaching	Below surface					
			cover	Total submerged	Sub- total	Species	Sub- total	Species	Total emergent	Species		
1	3.1	6.5	0	0					0			
2	2.9	6.5	0	0					0			
3	1.8	7.0	0	0					0			
4	3.2	7.0	0	0					0			
5	4.0	6.5	0	0					0			

## Appendix D Macroinvertebrate taxa list

Creation					Si	tes										
Species	1	2	3	4	5	6	7	8	9	10						
Archichauliodes diversus	23	58		23	5	70		44	6	12						
Xanthocnemis zealandica	5						18									
Ameletopsis perscitus								9	3	4						
Acanthophlebia cruentata										1						
Austroclima sepia	5	12		23	13	80	53	53	67	31						
Austronella planulata								9								
Deleatidium spp.	7	198		12	47	55		9		58						
Coloburiscus humeralis					50	40		18	3	51						
Neozephlebia scita					7											
Nesameletus sp.					2	20			13	35						
Oniscigaster wakefieldi								1								
Rallidens mcfarlanei						1		1								
Zephlebia spp.					2	10	9	61		16						
Zephlebia borealis	16				6											
Zephlebia dentata	12	58		47	33		26	18		1						
Zephlebia inconspicua					1					19						
Zephlebia spectabilis					7				6							
Austroperla cyrene					2											
Megaleptoperla diminuta		1														
Megaloptoperla grandis									1							
Zelandobius spp.						10										
Zelandoperla decorata					8	5				1						
Aoteapsyche spp.			23	6		100		53		12						
Aoteapsyche catherinae			1													
Aoteapsyche colonica	5	1		53		75		18	10							
Helicopsyche spp.					6					16						
Hudsonema alienum			1				1	9	3							
Hudsonema amabilis	7	35				5		70		4						
Hydrobiosella mixta					5					1						
Hydrobiosis spp.						1				4						
Hydrobiosis copis								1								
Hydrobiosis parumbripennis						1										
Hydrobiosis gollanis										4						
Neurochorema spp.					1	15		18	13	4						
Neurochorema armstrongi									1							
Neurochorema confusum						10										

Species	Sites									
	1	2	3	4	5	6	7	8	9	10
Olinga feredayi	12	70								
Orthopsyche spp.		23			9					
Orthopsyche fimbriata					2				3	4
Orthopsyche thomasi	5									
Oxyethira albiceps			58	6		40	341	44	22	
Paroxyethira sp.			23				9	18		
Polyplectropus sp.					1			18		
Psilochorema sp.					1					
Pycnocentria evecta		23	280		1	10		464		16
Pycnocentrodes spp.	26	2543	642	53		135		26	337	16
Triplectides obsoletus /dolichos	12	1	12			15	53			1
Zelolessica cheira										4
Elmidae (larvae)	2	58		257	2	95	9	473	6	8
Elmidae (adult)								18		
Hydraenidae (A)					2	5				
Ptilodactylidae (larvae)		1								1
Rhantus sp.							1			
Aphrophila neozelandica					2	40			6	1
Austrosimulium sp.				41	1		9	9	10	43
Chironomus zealandicus	35									
Corynoneura sp.	5						26			
Cricotopus spp.	2		47			15	35	18	25	
Eriopterini sp.								1		
Eukiefferiella sp.	5									
Harrisius pallidus					1					
Kaniwhaniwhanus sp.								9		
Limonia nigrescens	7								1	
Lobodiamesinae									3	
<i>Macropelopiini</i> sp. = Tanypodinae	19				1	25		53	1	1
Muscidae			12						10	
Naonella forsythi						5	18		6	
Paradixa sp.	2				1	5	26			
Paralimnophila skusei	2				1			1		
Polypedilum spp.							18			1
Tabanidae						5				
Tanytarsus spp.			35			30	105	26	76	
Tanyderidae								1		
Zelandotipula sp.	2									

Species	Sites										
	1	2	3	4	5	6	7	8	9	10	
Potamopyrgus antipodarum	98	758	1540	706	4	90	1374	219	10	778	
Physa sp.				6			1				
Latia sp.			12	12	1	5			6	31	
<i>Lymnaea</i> sp.							9				
Sphaerium sp.	21										
Oligochaeta	40			1	1						
Planaria	19				7						
Ostracoda	44	1					26				
Paracalliope fluviatilis						1	53				
Paranephrops planifrons		1			1						