

Waihou and Piako ecological monitoring 2014

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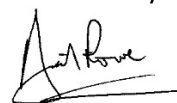
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Executive summary

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 higher in 2014 than in the previous surveys carried out in 2012 and 2013. However, inanga were again absent from all five sites (compared with being present at two of the sites in 2012). In the Waihou, the relative abundance of all fish species except longfin eels and torrentfish was also higher in 2014 compared to previous surveys. The numbers of longfin eels and torrentfish were generally lower. Macroinvertebrate communities in the Piako sites were generally improved relative to previous surveys, but in the Waihou catchment macroinvertebrate communities had declined. At some of the sites there is evidence of progressive increases in macrophyte and periphyton cover. In general this is 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 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. This 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). 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 2011). 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 & Bartels 2012, Franklin & Booker 2009, Franklin et al. 2011, Franklin et al. 2013).

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 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 2014 during a period of sustained summer low flows (Table 2-1 & Figure 2-1). The sites were those recommended by Franklin et al. (2013) and, with the exception of Site 10 on the Waitawheta River, all had been sampled at least once previously. Site 10 was established as a new site in the Ohinemuri sub-catchment, downstream of the Ohinemuri weir which is considered a barrier to upstream fish migrations.

Table 2-1: Location of the 2014 ecological monitoring sites in the Waihou and Piako catchments.

* Denotes new site in 2014. 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 | 1831220 | 5809988 | 100 | 160 |
| 6 | Waihou | Paiakarahi Stream D/S | 1841027 | 5867879 | 34 | 60 |
| 7 | Waihou | Karengorengo Stream | 1848393 | 5823235 | 100 | 30 |
| 8 | Waihou | Wairere Stream | 1851660 | 5819808 | 108 | 40 |
| 9 | Waihou | Waiteariki Stream | 1852566 | 5818150 | 112 | 97 |
| 10 | Waihou | Waitawheta River* | 1845480 | 5849662 | 71 | 177 |

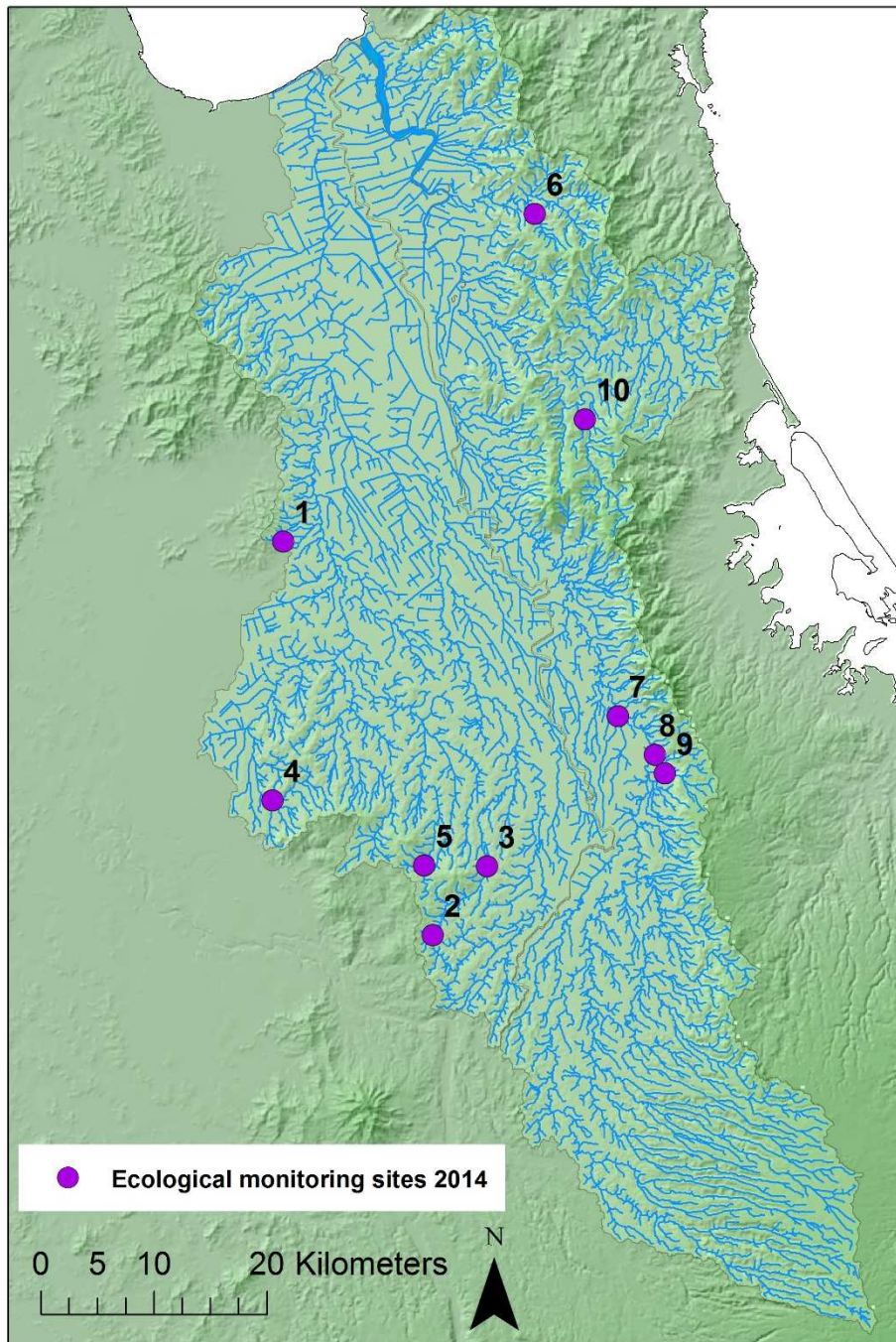


Figure 2-1: Map of ecological survey sites sampled in 2014. Site numbers refer to those in Table 2-1.

2.2 Fish

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

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

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

2.3 Macroinvertebrates

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

Samples were processed using the recommended MfE Protocol P2 (200 individual fixed count and scan for rare taxa) (Stark et al. 2001). This provides proportional abundance data suitable for the calculation of most invertebrate parameters (Collier & Kelly 2005). Complete taxonomic lists were compiled and a range of community metrics calculated at the taxa level indicated in Collier 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

A total of six different native fish species were recorded throughout the five survey sites in the Piako catchment during the 2014 survey (Table 3-1). No exotic species were captured even though they are known to be present and locally abundant in some areas of the Piako catchment. Both shortfin (*Anguilla australis*) and longfin eels (*Anguilla dieffenbachii*) were present at all five sites, as were koura (*Paranephrops planifrons*), the freshwater crayfish. Bullies were also present at all sites, with common bullies (*Gobiomorphus cotidianus*) found 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. The other species recorded were banded kokopu (*Galaxias fasciatus*) in the Mangakahika and Piakonui, and torrentfish (*Cheimarrichthys fosteri*) in the Waitakaruru.

The relative abundance of fish was higher in 2014 than in previous surveys at all sites (Figure 3-1). However, species richness was lower in the Mangapapa and Waitoa sites where neither torrentfish nor inanga (*Galaxias maculatus*) have been recorded since 2012. At the Piakonui site, species richness has increased compared to 2013 with the addition of bullies, which were abundant at this site in 2014. A sub-sample of bullies was collected for identification in the laboratory. Based on the current key for bullies, they were identified as common bullies on the basis of pores being present on the head. However, there is increasing uncertainty around the effectiveness and consistency of some of the morphological differences that are typically used to distinguish between common and Cran's bullies. Given the location in the catchment, upstream of what is considered to be a natural migration barrier to swimming fish species just upstream of Morrinsville, the non-migratory Cran's bully would be considered more likely to occur at this site. Consequently, this should be treated with caution until more reliable differentiation between the species can be achieved. Also notable at this site was the extremely high abundance of koura. The continued presence of good numbers of banded kokopu across a range of sizes (64 - 150 mm) in the Mangakahika site maintains the significance of this site from a biodiversity perspective, especially given the generally low occurrence of this species at other sites surveyed in the Piako catchment.

Fish length data provide information on fish recruitment and survival rates. Length-frequency relationships for shortfin eels and the two bully species in 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 Waitakaruru and Waitoa survey sites, where populations were dominated by eels <200 mm in length. This indicates good recruitment of elvers (juvenile eels) has occurred at these sites in the last couple of years. In the 200-400 mm size range, the abundance of eels decreases with size at both sites. This is considered consistent with habitat constraints at these sites, with the relatively small stream size limiting the availability of larger pool habitats that larger eels can inhabit. Downstream migration of adult male shortfins also typically occurs at between 350-500 mm in length (Todd 1980), which will also contribute towards the observed declines in abundance of eels in this size range. However, shortfin eels >500 mm are generally females, which migrate at a larger size than males. The very low abundance of shortfin eels in these larger size classes (they are absent from all sites except Waitakaruru) indicates that few females are reaching maturity in these locations.

Recruitment of Cran's bullies appears to be good at all three sites (Mangapapa, Waitakaruru and Waitoa) where they are present, with good numbers of juveniles (<30 mm) recorded (Figure 3-2). However, larger adults (>50 mm) are only present in good numbers at the Waitoa site. This either indicates better growth rates at this site, or poorer survival of adults at the other two sites. At the two sites where common bullies were present, the diadromous recruitment of this species results in fewer fish in the smallest (<30 mm) size classes. The occurrence of larger size classes at the Piakonui site indicates that multiple year classes are present, even though this species was absent from this site in 2013. This suggests a significant redistribution of this species has occurred into this reach in the last year. The absence of this species in 2013 could have been a consequence of some parts of this reach being completely dry during the drought conditions.

Longfin eels were only present in low numbers at all sites and the majority of those captured were >500 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 indicate relatively poor recruitment of this species. Given that small numbers of large individuals dominate the populations of longfin eels at these sites and that the species is long-lived (female age at maturity >20 years), there is a risk that there may have been poor recruitment of this species to these sites for a number of decades.

Table 3-1: Results of 2014 electric fishing survey at the five Piako catchment monitoring sites. Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m²).

| Site | Shortfin eel | | Longfin eel | | Cran's bully | | Common bully | | Torrentfish | | Banded kokopu | | Koura | |
|-----------------------|--------------|----------|-------------|----------|--------------|----------|--------------|----------|-------------|----------|---------------|----------|-------|----------|
| | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. |
| 1. Mangakahika Stream | 30 | 13.3 | 8 | 3.5 | - | - | 21 | 9.3 | - | - | 27 | 11.9 | 7 | 3.1 |
| 2. Waitoa Stream | 120 | 49.1 | 6 | 2.5 | 135 | 55.2 | - | - | - | - | - | - | 59 | 24.1 |
| 3. Mangapapa Stream | 26 | 4.8 | 3 | 0.6 | 91 | 16.6 | - | - | - | - | - | - | 31 | 5.7 |
| 4. Waitakaruru Stream | 89 | 29.7 | 10 | 3.3 | 88 | 29.3 | - | - | 1 | 0.3 | - | - | 38 | 12.7 |
| 5. Piakonui Stream | 7 | 1.9 | 4 | 1.1 | - | - | 22 | 6.0 | - | - | 4 | 1.1 | 200 | 54.6 |

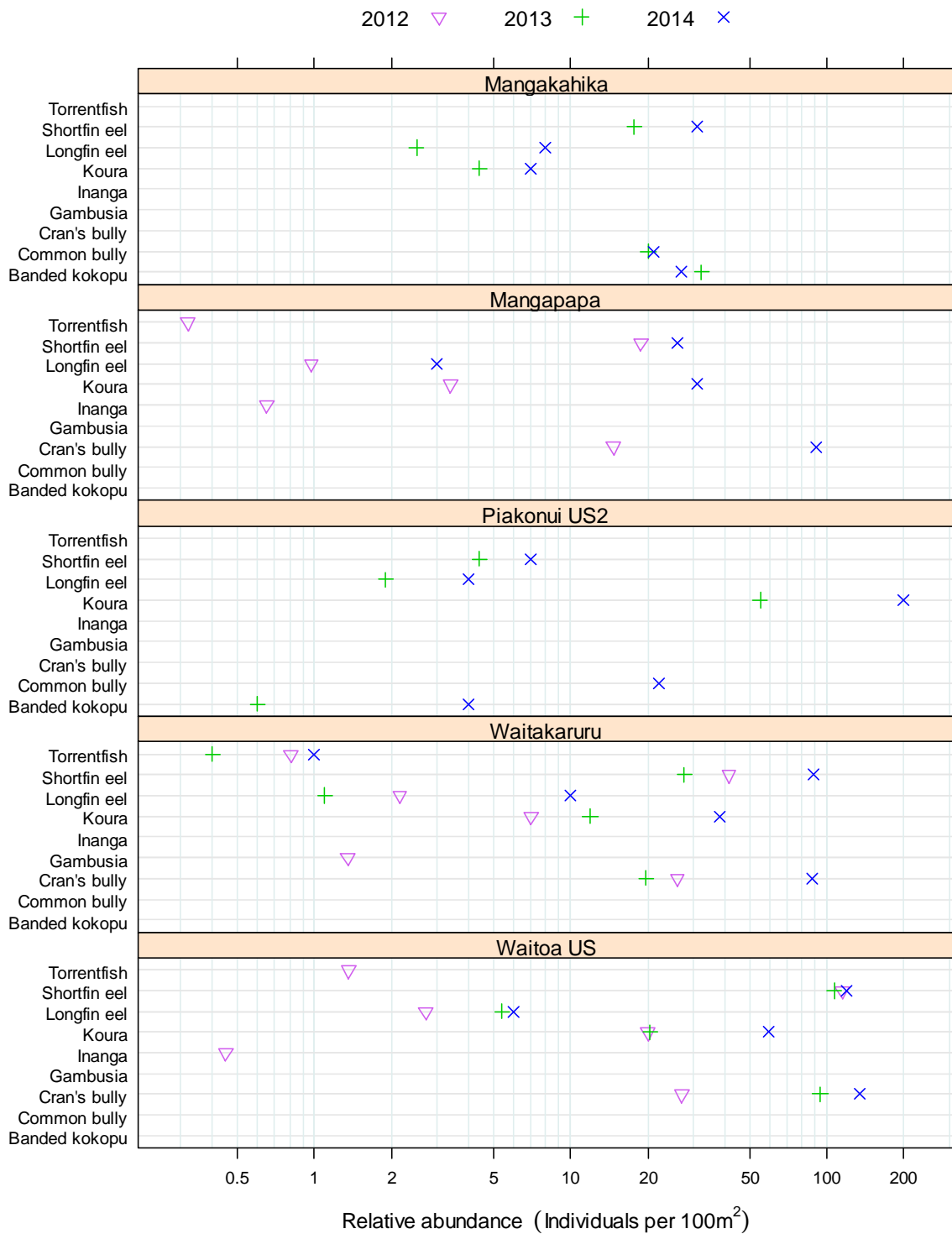


Figure 3-1: Comparison between the relative abundance of fish captured in the 2012, 2013 and 2014 Piako surveys. The Mangakahika Stream and Piakonui US2 sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013. Note the logarithmic x-axis.

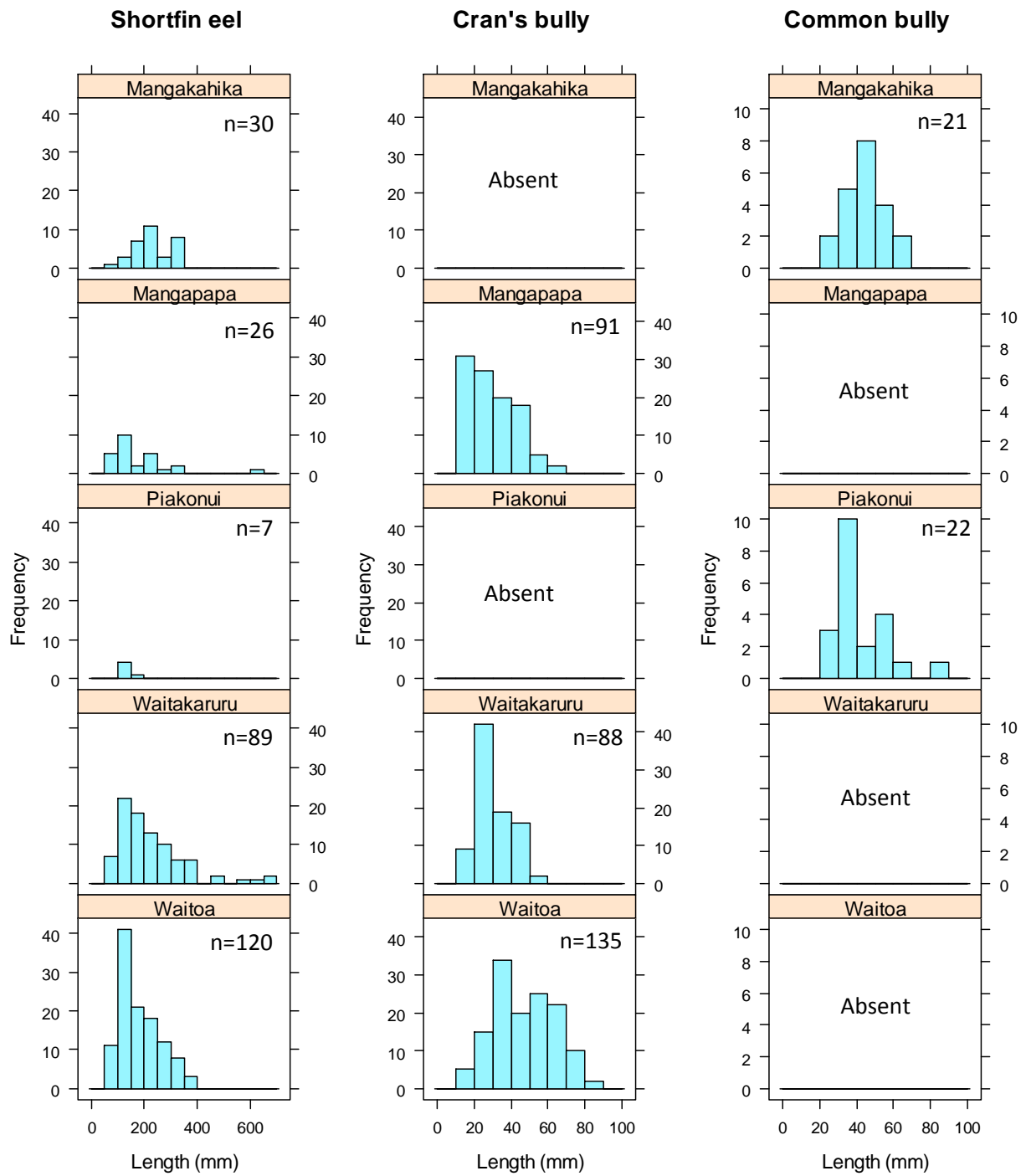


Figure 3-2: Length-frequency relationships for the most abundant fish species at each site in the Piako.

3.1.2 Macroinvertebrates

All sites were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m² 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 have greater biodiversity and a higher proportion of these types of sensitive species than intensively developed (i.e., pasture) catchments (Boothroyd & 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 & 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 & Maxted 2007).

Total taxa richness and EPT richness were highest at the Piakonui survey site (Table 3-2). The %EPT and MCI scores were also highest at this site. This reflects the habitat at this site which was characterised by diverse instream physical habitat and intact native riparian bush cover. Compared with 2013 there has been a large improvement in the macroinvertebrate community at this site (Figure 3-3). In 2013, part of this reach dried out as a consequence of prolonged low flows. However, in 2014 water was flowing through the whole reach suggesting that the improvement in macroinvertebrates at this site is likely a result of higher flows. The lowest taxa richness in 2014 was recorded at the Mangapapa site (Table 3-2). This most likely reflects the high percentage of bedrock at this site. An extremely low score for %EPT was recorded at this site (Table 3-2) reflecting the abundance of snails (*Potamopyrgus*) at this site.

MCI scores declined between 2013 and 2014 in the Mangakahika, but improved in the Piakonui and Waitakaruru. However, the 2014 MCI score for the Waitakaruru was lower than the score recorded in the first survey in 2012 (Figure 3-3). In contrast, at the Waitoa and Mangapapa sites, MCI scores increased between 2012 and 2014. In 2014, three of the sites fell in the ‘good’ range, one in the ‘excellent range, and one in the ‘fair’ quality class.

Table 3-2: Summary of macroinvertebrate results for the Piako monitoring sites in 2014.

| Site | Total taxa richness | EPT richness | %EPT | MCI |
|-----------------------|---------------------|--------------|------|-------|
| 1. Mangakahika Stream | 20 | 11 | 58.7 | 107.0 |
| 2. Waitoa Stream | 15 | 10 | 69.9 | 113.3 |
| 3. Mangapapa Stream | 9 | 6 | 2.0 | 106.7 |
| 4. Waitakaruru Stream | 13 | 5 | 38.6 | 90.8 |
| 5. Piakonui Stream | 28 | 15 | 83.5 | 137.1 |

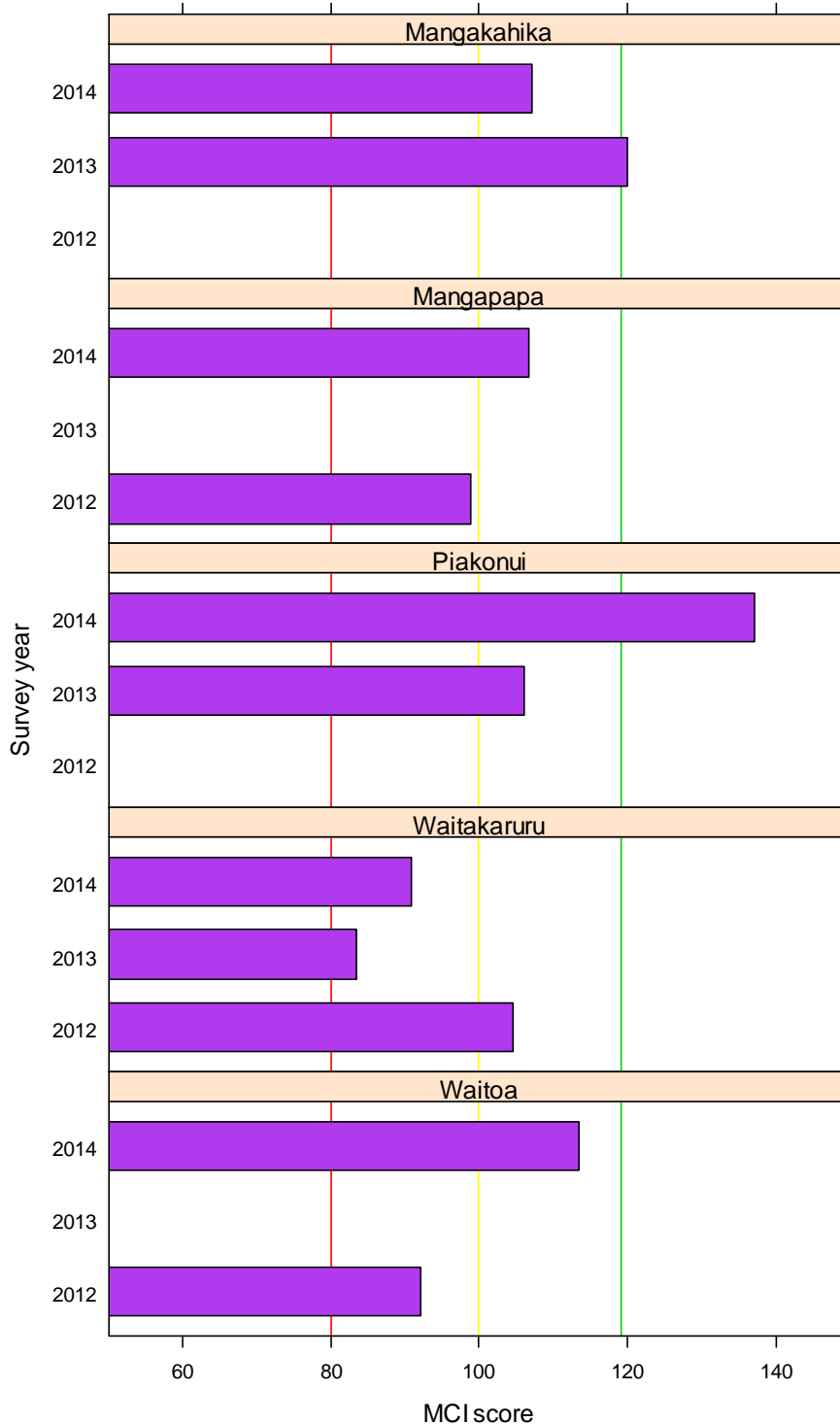


Figure 3-3: Comparison of MCI scores between survey years in the Piako catchment. Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007) The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013. Macroinvertebrate results from the Waitoa in 2013 are not available.

3.1.3 Macrophytes & periphyton

Three of the five sites have no or low macrophyte cover present (Figure 3-4). However, in both the Waitakaruru and Waitoa sites, there was a significant increase in the macrophyte cover in 2014 compared to previous years (Figure 3-4). This was particularly the case in the Waitoa site, where the MTC score increased from zero to 56% between 2013 and 2014. This was largely driven by a proliferation of watercress (*Nasturtium officinale*) within the reach. In the Waitakaruru, the increase in macrophyte cover to 15% was a result of the expansion of the exotics *Lagarosiphon major* and *Potamogeton crispus*.

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). However, at the Waitakaruru site the PEI score has increased significantly over the past three years from 10 in 2012 to 85.6 in 2014 (Figure 3-5). Given the concurrent increase in macrophyte growth at this site, this may be indicative of increasing eutrophication (nutrient enrichment) at this site.

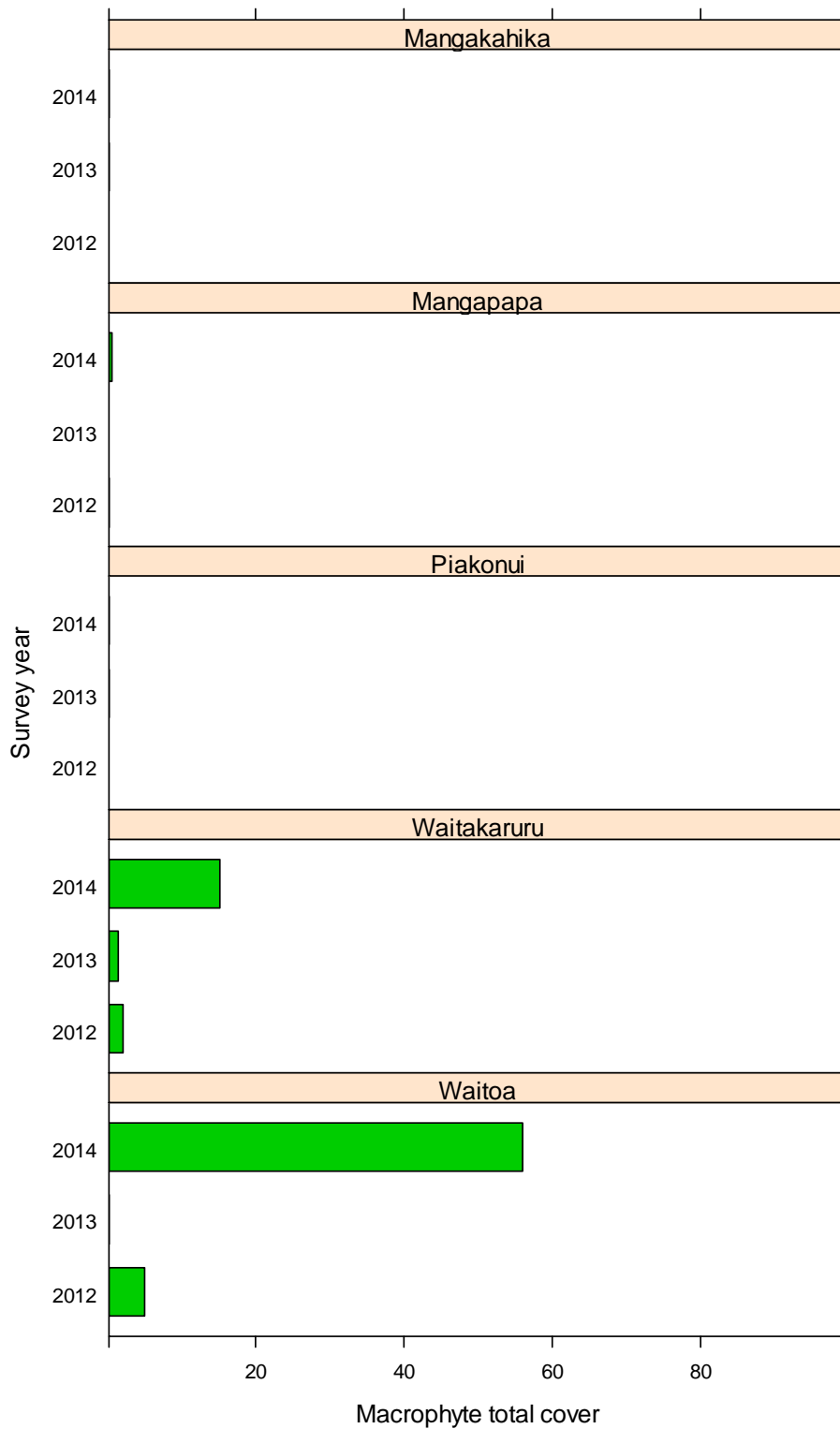


Figure 3-4: Comparison of macrophyte total cover (MTC) scores over time at the Piako survey sites. The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013.

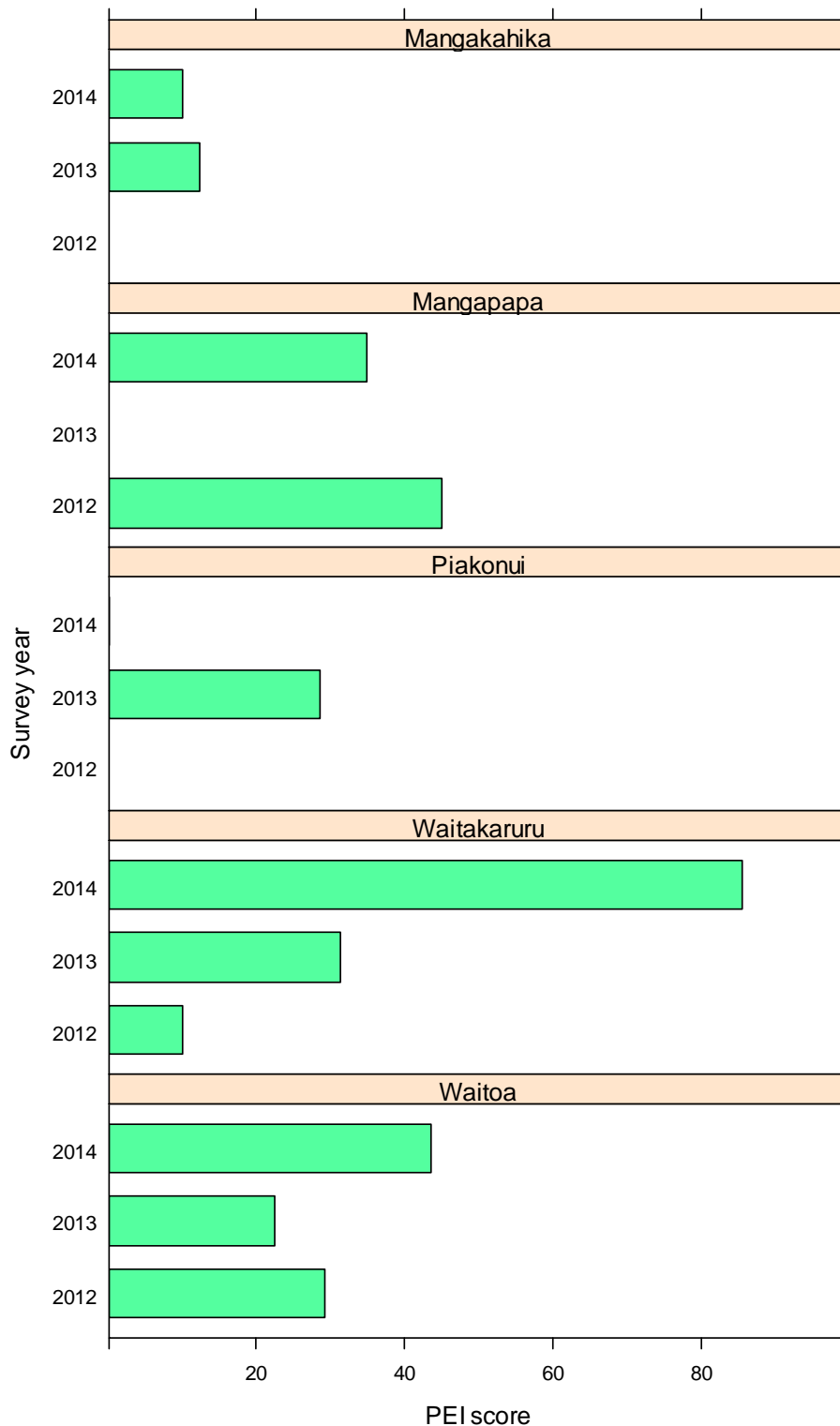


Figure 3-5: Comparison of periphyton enrichment index (PEI) scores over time at the Piako survey sites. The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013.

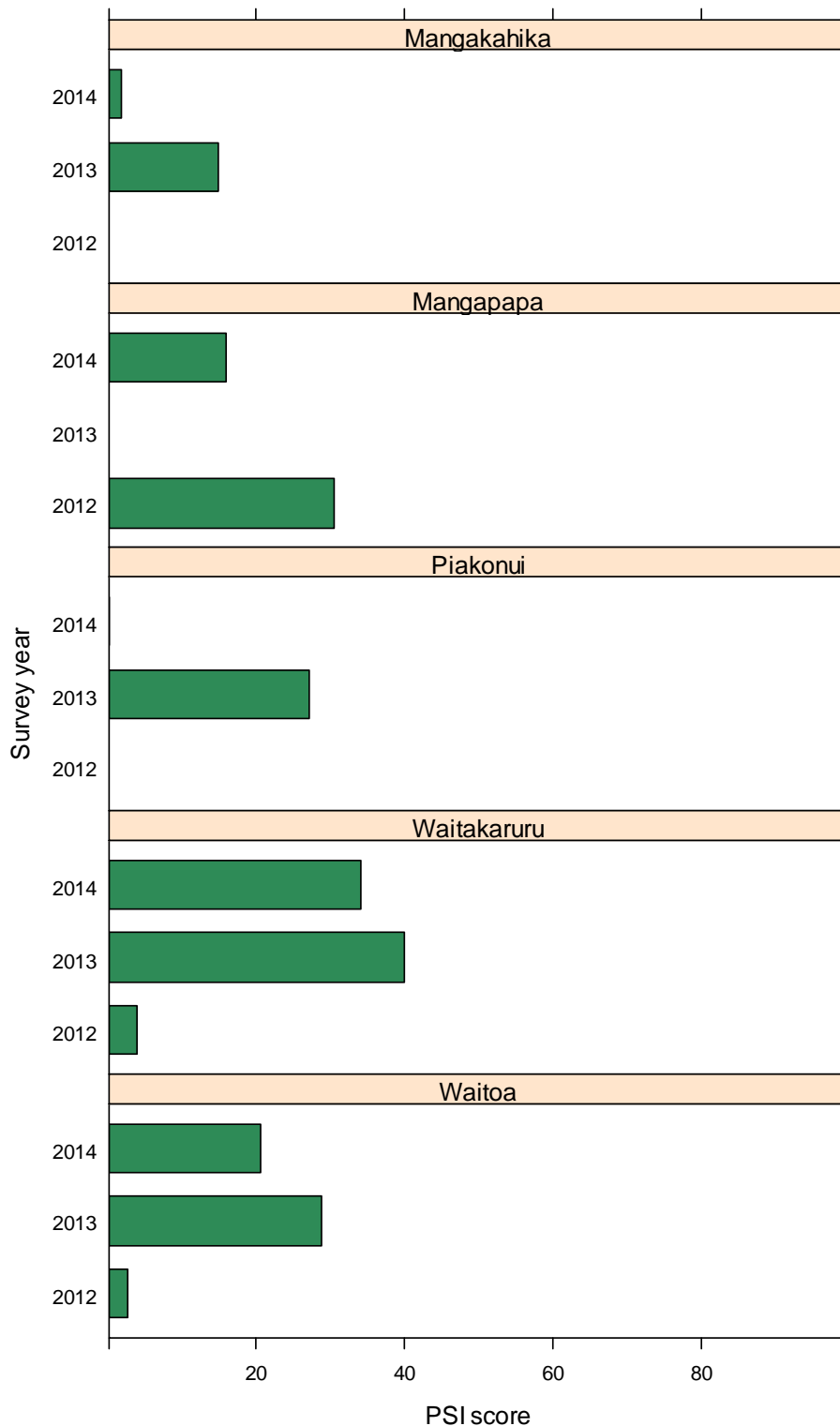


Figure 3-6: Comparison of periphyton sliminess index (PSI) scores over time at the Piako survey sites. The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013.

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 Mangakahika, 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 Waitakaruru and Waitoa sites. It is unclear what the main driver of changes in the Waitakaruru site is, however at the Waitoa site the reduction in habitat quality is likely to be a direct result of increased access to the stream by cattle. In 2009 cattle were fenced from the stream (using temporary single wire electric fences). However, these are no longer in use and no permanent fencing has been erected. As a consequence cattle now have direct access to the stream which has been observed to have increased erosion and fine sediment deposition, altered channel morphology and reduced riparian cover.

Correlations between habitat score and biotic indices were evaluated using the non-parametric Spearman's rank correlation (ρ). Samples from all survey years were pooled ($n=11$). The macroinvertebrate indices all correlated positively with the habitat score indicating a general improvement in macroinvertebrate communities with increasing habitat score. There was a relatively strong correlation between the habitat score and MCI score ($\rho=0.58$; Figure 3-8). The correlation between habitat score and fish species richness was positive, but relatively weak ($\rho=0.18$; Table 3-3). However, this may in part reflect the limited range in fish species richness (3-5 species) found in the Piako survey sites.

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

| Biotic index | Spearman's rank correlation coefficient |
|----------------------------------|---|
| MCI | 0.58 |
| Macroinvertebrate total richness | 0.43 |
| EPT richness | 0.40 |
| Fish richness | 0.18 |

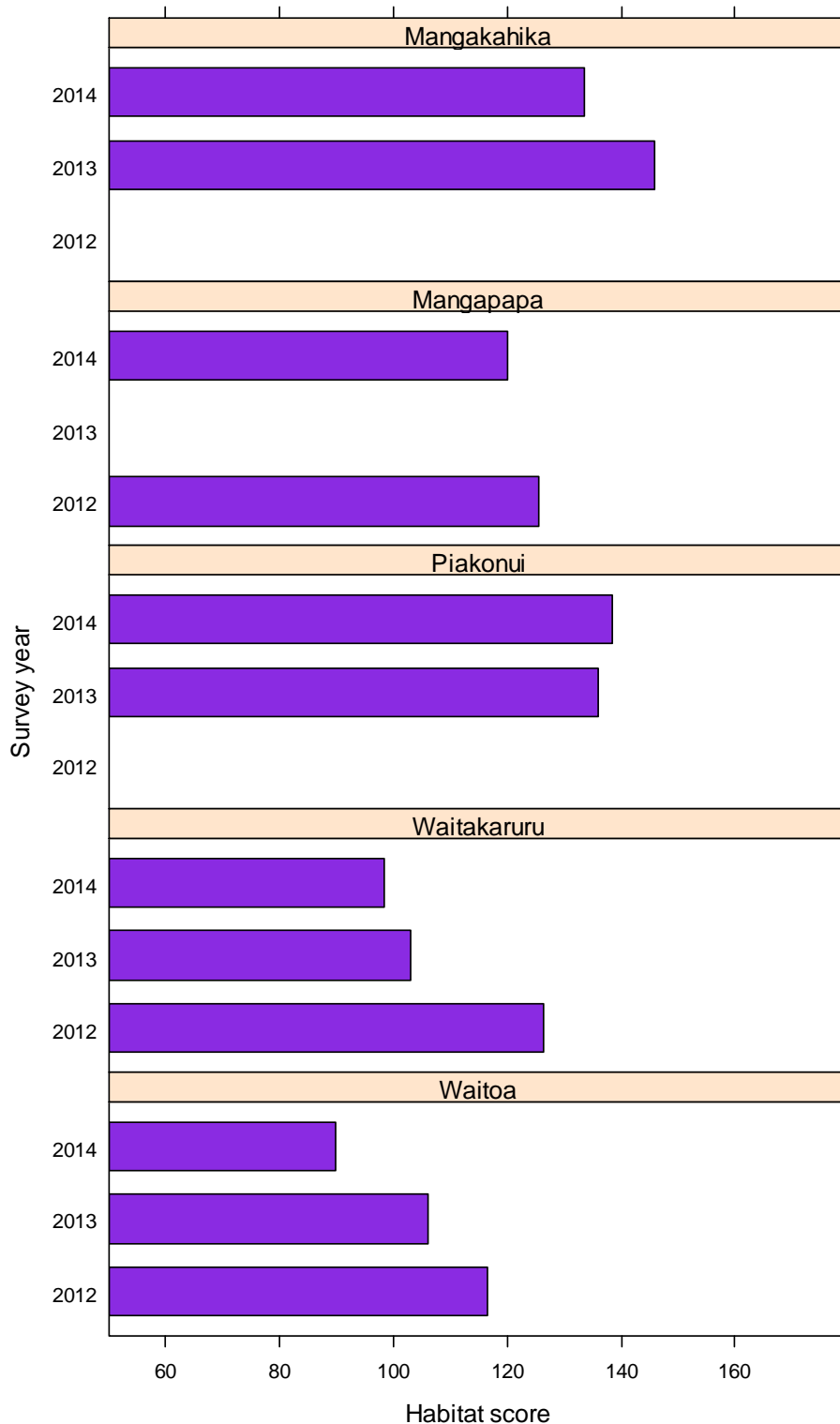


Figure 3-7: Comparison of habitat scores over time for the Piako survey sites. The Mangakahika Stream and Piakonui sites were not surveyed in 2012. The Mangapapa Stream at this location was not surveyed in 2013.

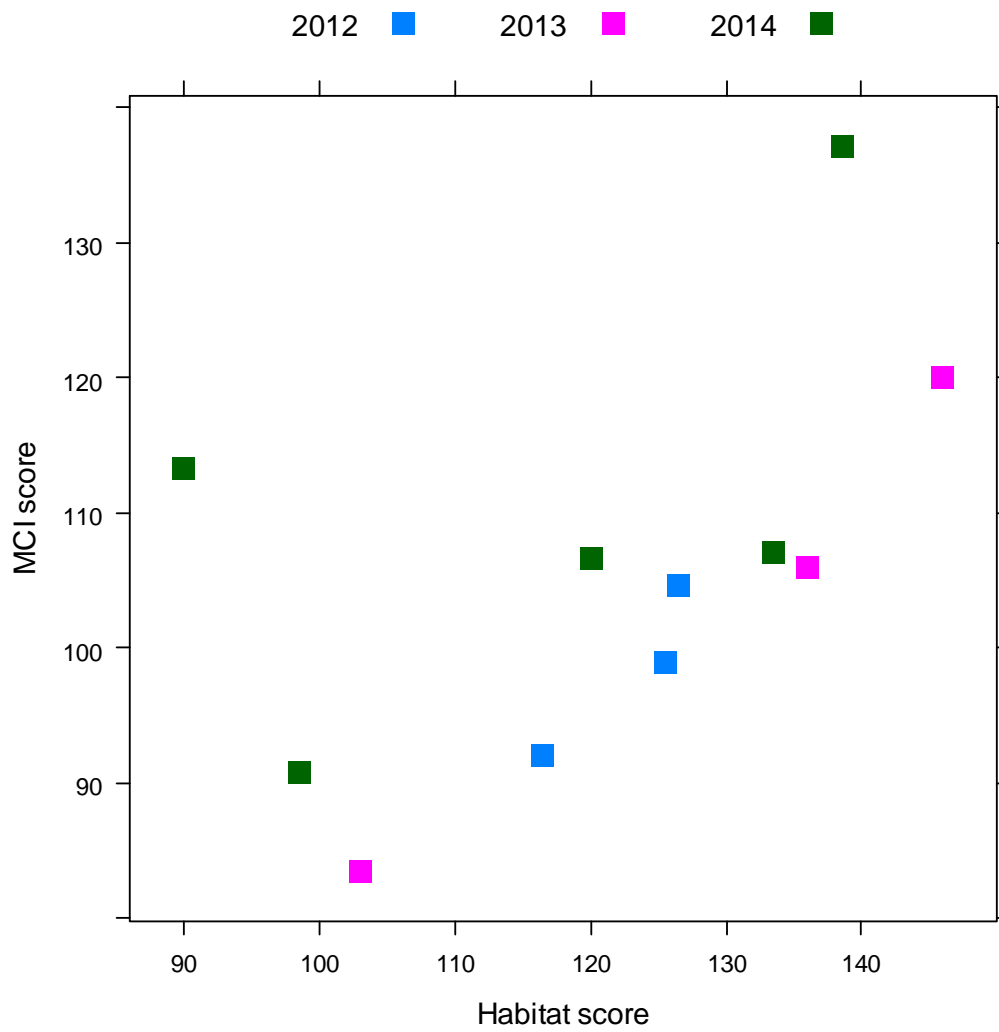


Figure 3-8: Scatterplot of habitat score against MCI score at the Piako survey sites in different survey years ($\rho=0.58$). No MCI score was available for the Waitoa site in 2013.

3.2 Waihou catchment

3.2.1 Fish

Ten different fish species were recorded among the five Waihou survey sites in 2014, eight of which were native and two of which were exotic species (Table 3-4). Shortfin eels were the only species present at all five sites, with longfin eels and brown trout (*Salmo trutta*) recorded at four sites each. The greatest species richness (7) was recorded in the Paiakarahi survey site, where shortfin eels, longfin eels, Cran's bully, torrentfish, inanga, banded kokopu and rainbow trout (*Oncorhynchus mykiss*) 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.

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 meaning that capture efficiency here was extremely poor and it is suspected that the abundance (and probably species richness) of fish was well underestimated for this site. This was particularly evident for shortfin eel and smelt, which were recorded in much lower numbers in 2014 compared to previous surveys. The absence of longfin eel and inanga in the 2014 survey results at this site are also likely a result of the poor sampling conditions.

At the Paiakarahi sampling site, the abundance of torrentfish, both eel species and Cran's bully was much greater in 2014 than in any of the three previous surveys (Figure 3-9). Inanga, banded kokopu and rainbow trout were also recorded at close to their highest numbers at this site. Koura were also recorded at a higher abundance than previously at this site.

At the Wairere Stream site, the abundance of both shortfin eels and common bullies was significantly higher than in the previous survey in 2011 (Figure 3-9). This was a consequence of high numbers of juvenile fish being captured (Figure 3-10). However, the numbers of torrentfish and longfin eel were lower, and no inanga were recorded in 2014. One new species was recorded at this site, which was brown trout.

At the Waiteariki survey site, the numbers of fish recorded in 2014 were generally similar to those in the 2011 survey (Figure 3-9). The main differences were a significant reduction in the number of torrentfish captured and the appearance of seven banded kokopu (as opposed to one unidentified galaxiid recorded in 2011).

Length-frequency relationships indicate a high level of recruitment of juvenile shortfin eels in the Wairere Stream this year (Figure 3-10). However, at all sites there was a generally low abundance of shortfin eels, particularly in the >200 mm size range. Shortfin eels >400 mm were extremely rare. Given the presence of large longfin eels at most of these sites, this suggests there may be poor survival or growth of shortfin eels in these sites as opposed to them being habitat limited. This is of potential concern for future recruitment of this species. 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 this may be an indicator of poor recruitment of this species in recent years. The sites on the Paiakarahi and Waitawheta streams had the highest numbers of longfin eels. The Paiakarahi was the only site where small (<200 mm) longfin eels were recorded. Both species of bullies appear to be recruiting well at the sites where they are present, with a wide range of sizes represented. Several bullies of >70 mm were recorded in the Waiteariki, Wairere and Waitawheta sites indicating good survival and growth rates.

Table 3-4: Results of 2014 electric fishing survey at the five Waihou catchment monitoring sites. Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m²).

| Site | Shortfin eel | | Longfin eel | | Cran's bully | | Common bully | | Torrentfish | | Inanga | | Smelt | | Banded kokopu | | Rainbow trout | | Brown trout | | Koura | |
|--------------------------|--------------|----------|-------------|----------|--------------|----------|--------------|----------|-------------|----------|--------|----------|-------|----------|---------------|----------|---------------|----------|-------------|----------|-------|----------|
| | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. | Ab. | Rel. Ab. |
| 6. Paiakarahi Stream D/S | 8 | 1.6 | 8 | 1.6 | 64 | 13.0 | - | - | 5 | 1.0 | 1 | 0.2 | - | - | 1 | 0.2 | 3 | 0.6 | - | - | 32 | 6.5 |
| 7. Karengorengo Stream | 33 | 9.1 | - | - | - | - | 3 | 0.8 | - | - | - | - | 2 | 0.6 | - | - | - | - | 1 | 0.3 | 9 | 2.5 |
| 8. Wairere Stream | 254 | 31.1 | 2 | 0.3 | - | - | 965 | 118 | 2 | 0.3 | - | - | - | - | - | - | - | - | 1 | 0.1 | 58 | 7.1 |
| 9. Waiteariki Stream | 20 | 2.1 | 10 | 1.1 | 47 | 5.0 | - | - | 1 | 0.1 | - | - | - | - | 7 | 0.7 | - | - | 6 | 0.6 | 88 | 9.4 |
| 10. Waitawheta River | 23 | 4.5 | 16 | 3.1 | - | - | 64 | 12.6 | - | - | - | - | - | - | 1 | 0.2 | - | - | 3 | 0.6 | 10 | 2.0 |

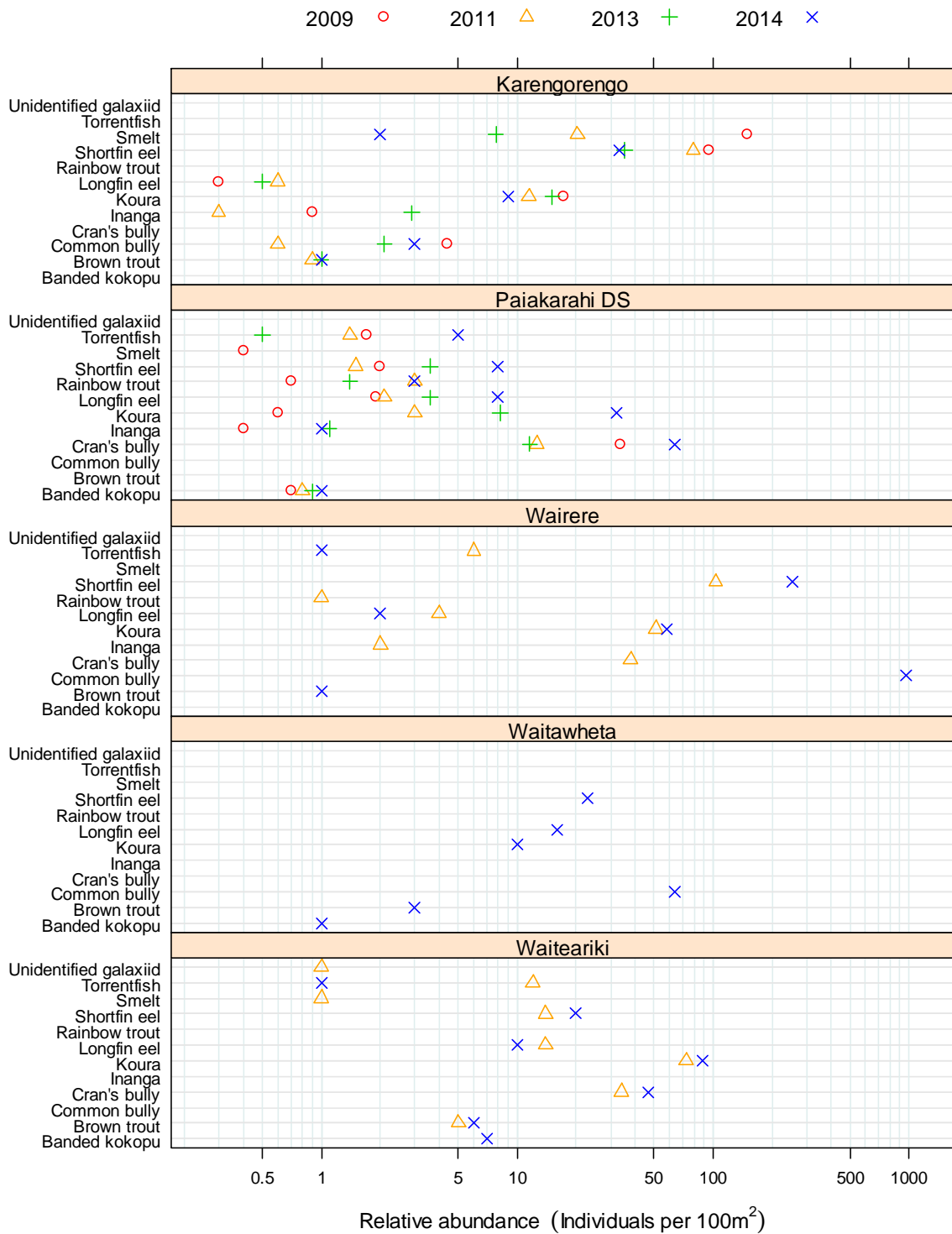


Figure 3-9: Comparison between the relative abundance of fish captured in the 2009, 2011, 2013 and 2014 Waihou surveys. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014. Note the logarithmic x-axis.

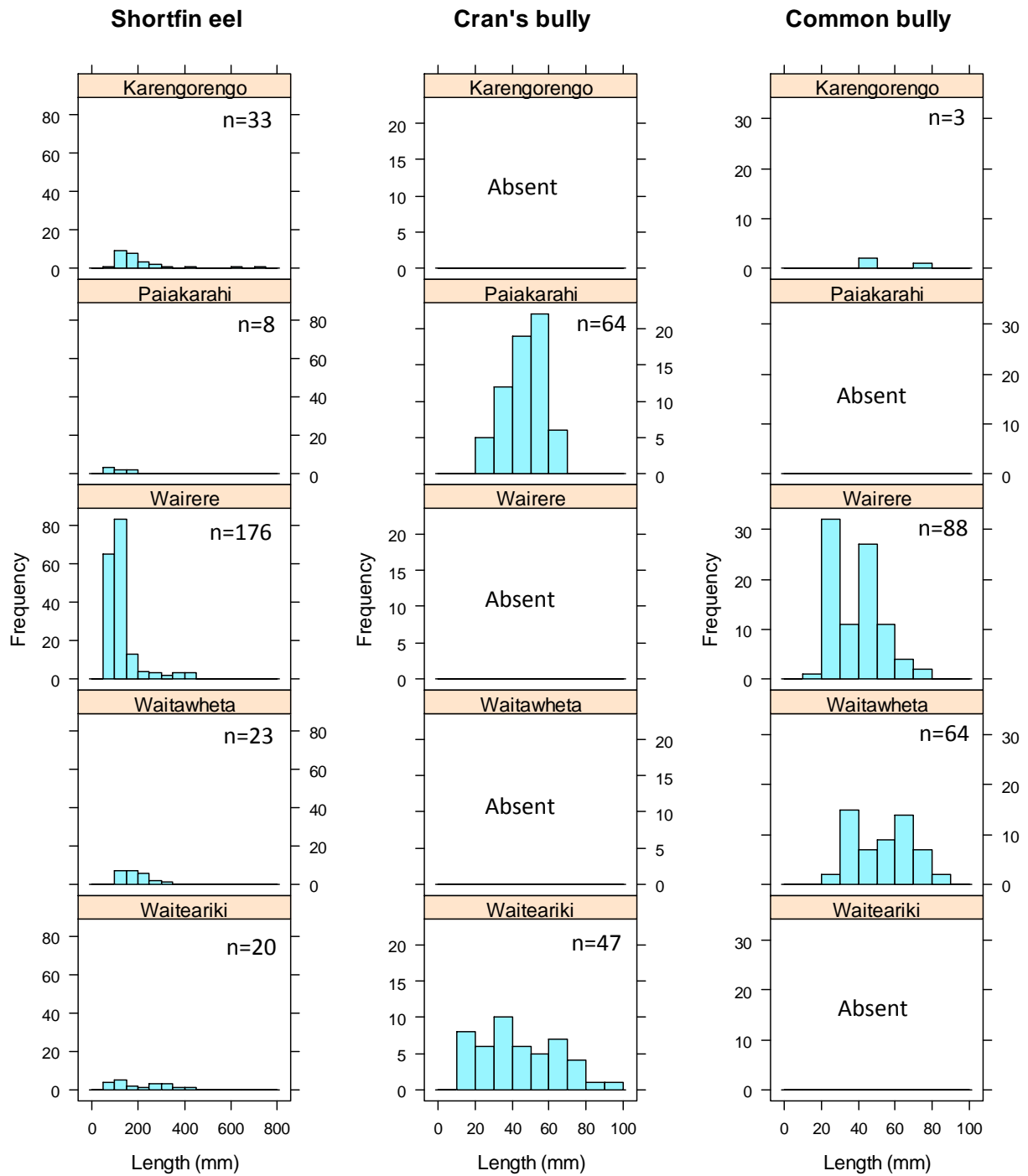


Figure 3-10: Length-frequency relationships for the most abundant fish species at each site in the Waihou.

3.2.2 Macroinvertebrates

Taxa richness was quite good at all sites, but total taxa richness and EPT richness were highest at both the Waiteariki and Waitawheta survey sites (Table 3-5). As a consequence of the high abundance of *Potamophyrus* at the Waitawheta site, the %EPT score was relatively low for this location, however it did have the highest MCI score and was the only site to fall in the 'Excellent' quality class in 2014 (Figure 3-11). The Waiteariki, Wairere and Paiakarahi sites were all classified in the 'Good' quality class based on their MCI score in 2014. However, the Karengorengo site was classified as only 'Fair' (Figure 3-11).

Compared to previous surveys, the MCI score at the Karengorengo site was similar to past results, reflecting the degraded, agriculturally impacted characteristics of this stream (Figure 3-11). The MCI scores for the Wairere, Waiteariki and Paiakarahi sites were lower in 2014 than in previous years. This was the first time in four surveys that the Paiakarahi site had dropped out of the 'Excellent' quality class based on MCI score (Figure 3-11). This has coincided with an increase in periphyton cover in the reach (see below). The Wairere and Waiteariki sites have also both dropped from the 'Excellent' to 'Good' quality classes between 2011 and 2014. Because these sites have only been sampled twice, it is not yet possible to determine the likely cause of these differences.

Table 3-5: Summary of macroinvertebrate results for the Waihou monitoring sites in 2014.

| Site | Total taxa richness | EPT richness | %EPT | MCI |
|--------------------------|---------------------|--------------|------|-------|
| 6. Paiakarahi Stream D/S | 18 | 9 | 50.2 | 105.6 |
| 7. Karengorengo Stream | 18 | 7 | 22.1 | 97.8 |
| 8. Wairere Stream | 17 | 10 | 35.2 | 101.2 |
| 9. Waiteariki Stream | 29 | 20 | 78.3 | 117.2 |
| 10. Waitawheta River | 29 | 21 | 23.5 | 125.5 |

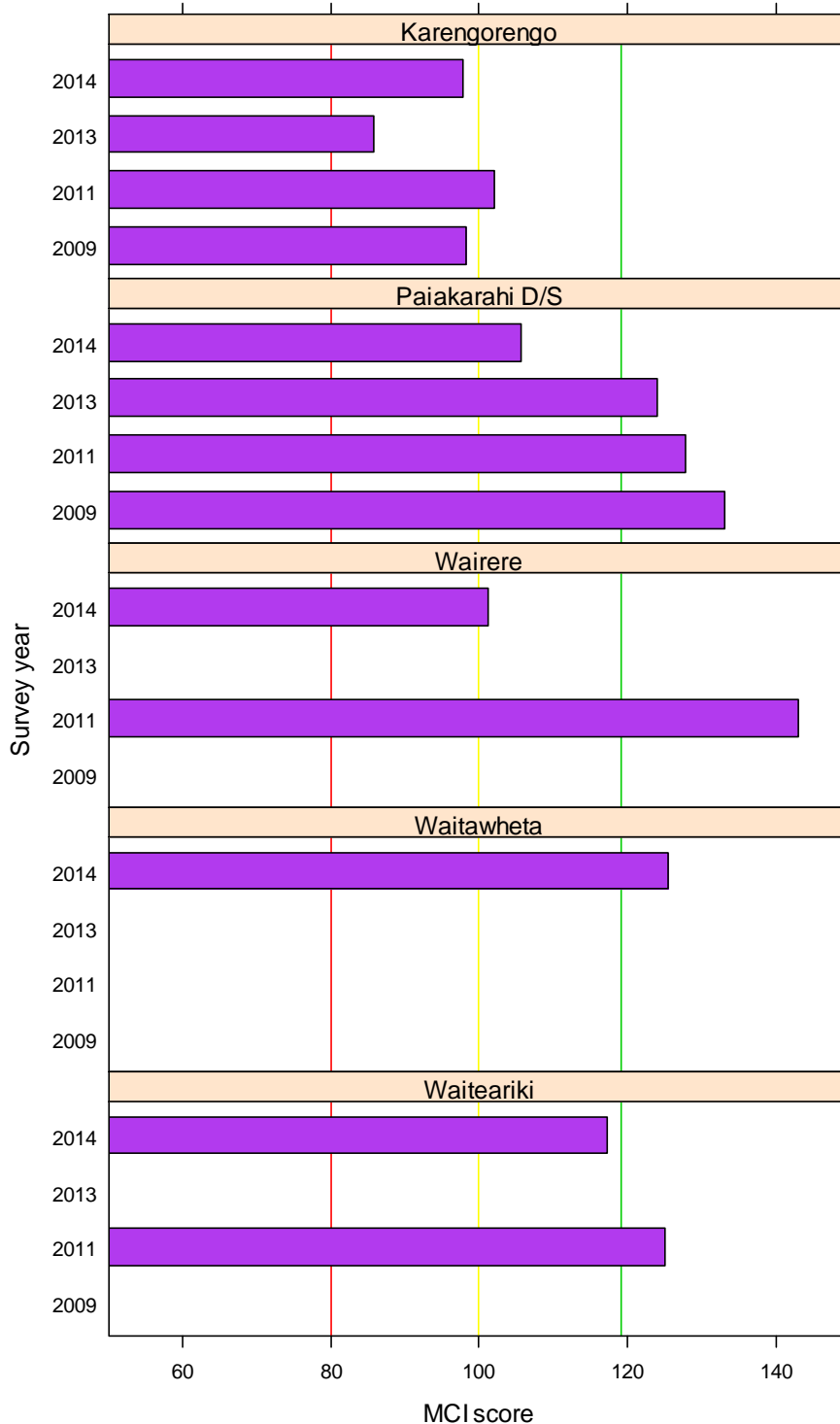


Figure 3-11: Comparison of MCI scores between survey years in the Waihou catchment. Vertical lines indicate boundaries for quality classes. Anything below the red line is 'poor', between the red and yellow lines is 'fair', between the yellow and green lines is 'good' and above the green line is 'excellent' (Stark & Maxted 2007) Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014.

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 Stream survey site, there has been a progressive increase in macrophyte cover since 2009, such that in 2014 the whole channel was clogged with macrophytes (MTC = 98%). The dominant macrophyte is the emergent species *Apium nodiflorum* which has progressively encroached from the margins to now fill most of the channel. As a consequence of this expansion, sampling for fish is now extremely difficult at this site and most of the reach is now unfishable.

PSI scores have remained relatively stable over time at those sites where periphyton is present (Figure 3-14), however there were notable increases in the periphyton enrichment scores (PEI) at the Waiteariki, Wairere and Paiakarahi sites in 2014 (Figure 3-13). It is unclear what the main driver of this is at these sites and it remains to be seen whether this is a temporary increase or part of a long term trend. There was a relatively long period of stable low flows prior to the 2014 survey which would have allowed a period of continuous accrual of periphyton. However, flows were also low in 2013 and the PEI was low at the Paiakarahi site in 2013.

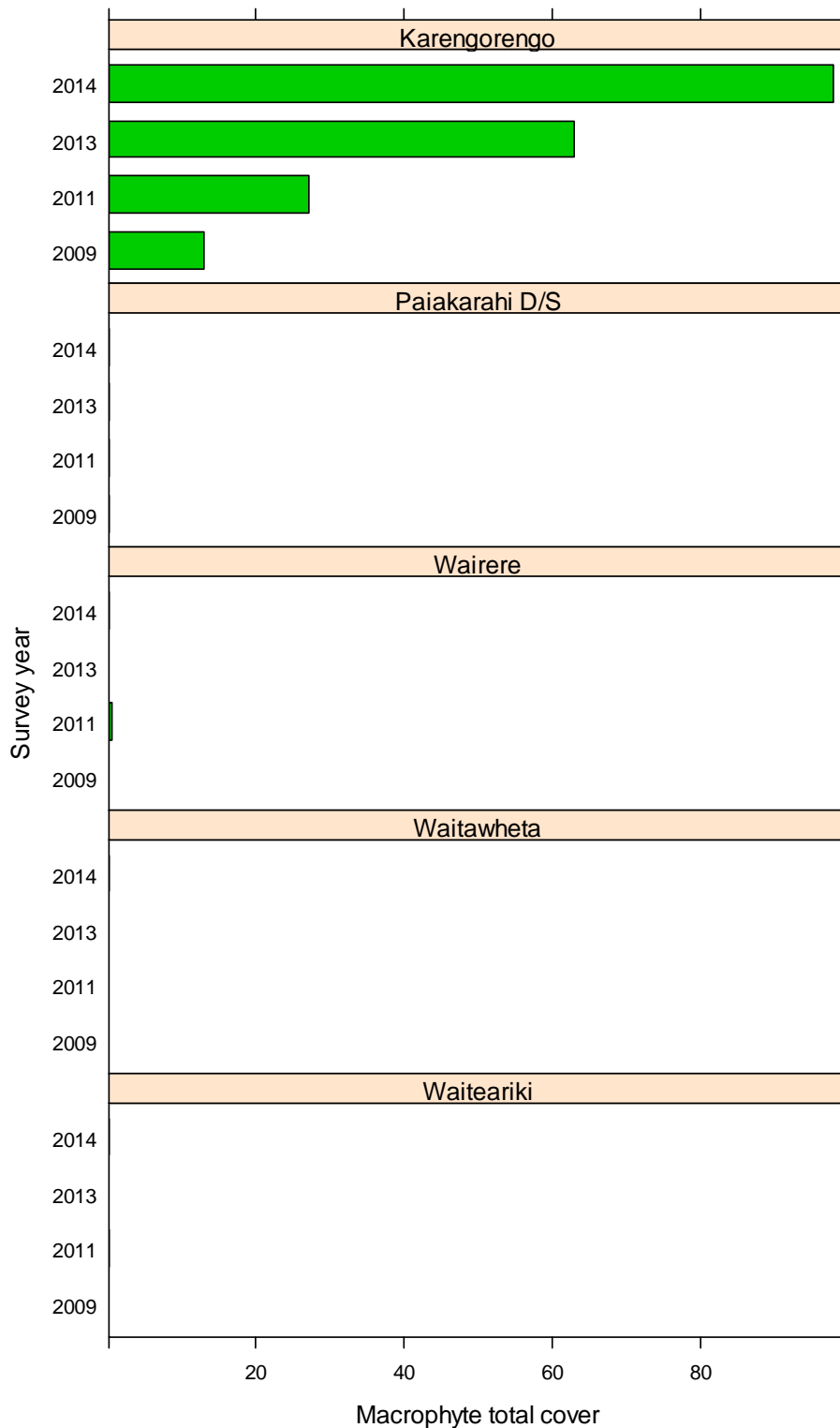


Figure 3-12: Comparison of macrophyte total cover (MTC) scores over time at the Waihou survey sites. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014.

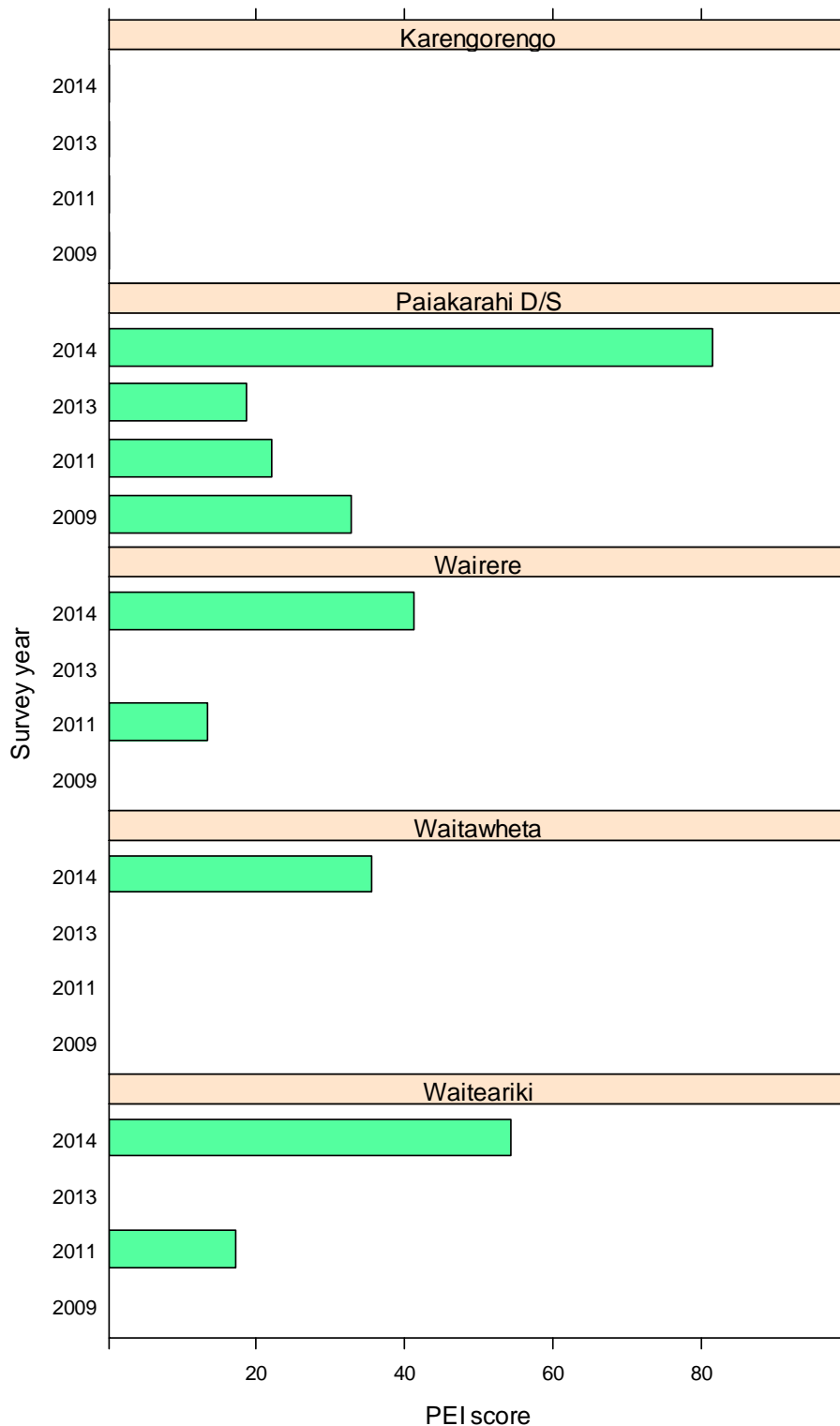


Figure 3-13: Comparison of periphyton enrichment index (PEI) scores over time at the Waihou survey sites. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014.

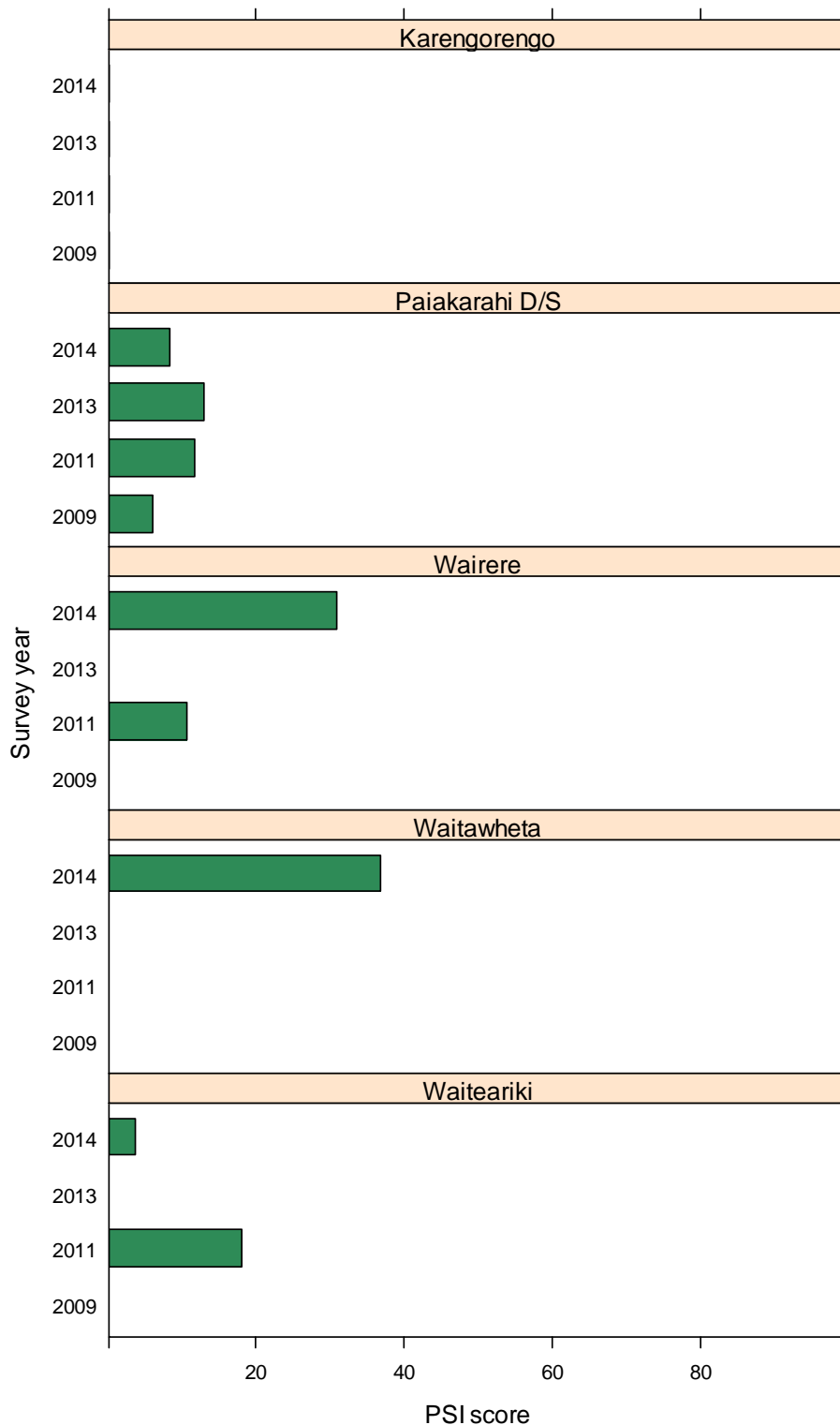


Figure 3-14: Comparison of periphyton sliminess index (PSI) scores over time at the Waihou survey sites. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014.

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 has been observed is the Karengorengo Stream where the habitat score has increased slightly over time. It is likely that this can be attributed to the exclusion of cattle from this gully by fencing which has reduced erosion in the stream. 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 (MCI $\rho=0.49$; %EPT $\rho=0.59$) (Table 3-6 & Figure 3-16). There was also a much stronger correlation between fish species richness and habitat score at the Waihou sites ($\rho=0.72$), 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 compared to the Piako (maximum 8 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 | 0.49 |
| Macroinvertebrate total richness | 0.47 |
| EPT richness | 0.50 |
| Fish richness | 0.72 |

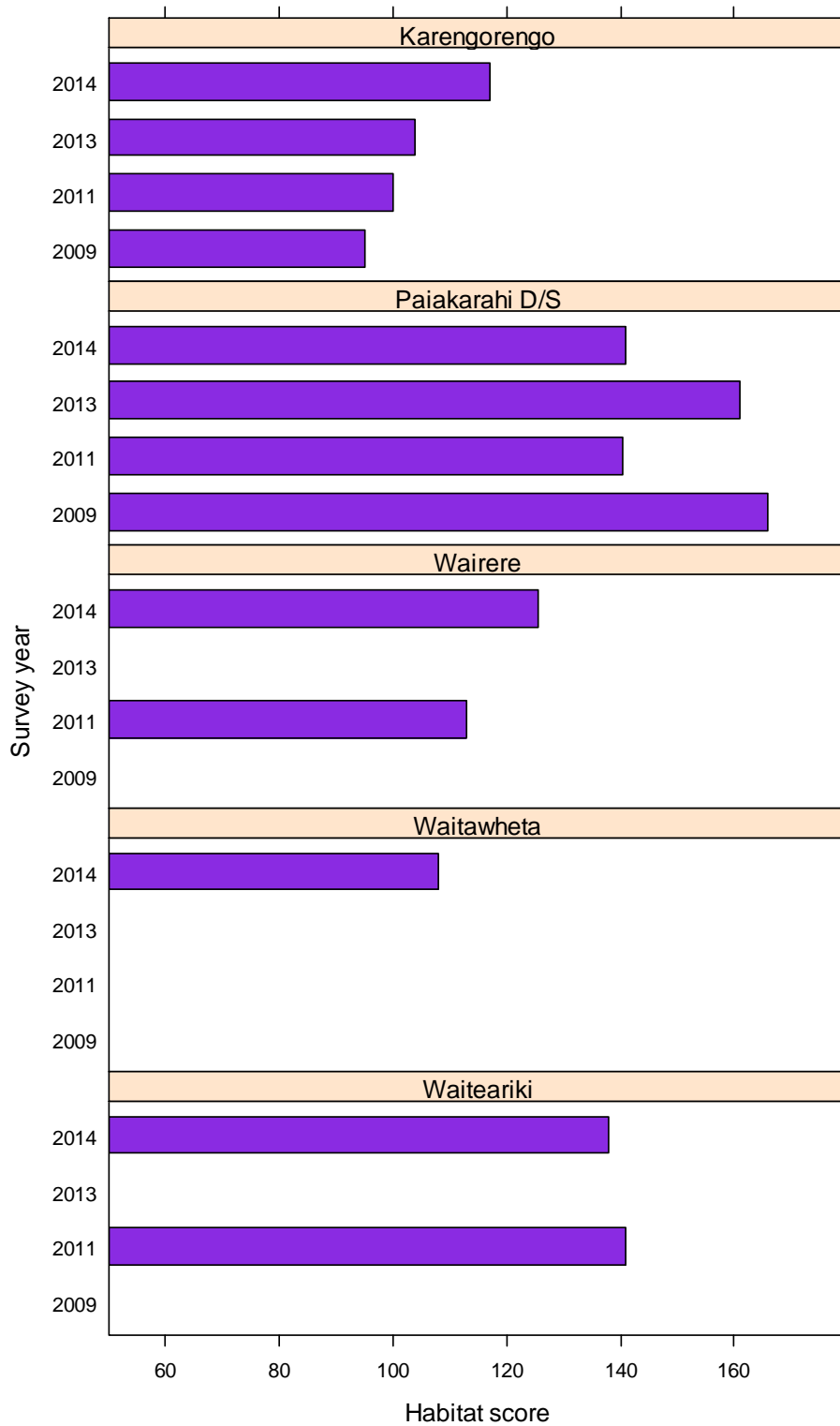


Figure 3-15: Comparison of habitat scores over time for the Waihou survey sites. Wairere Stream and Waiteariki Stream were only sampled in 2011 and 2014. The Waitawheta was only sampled in 2014.

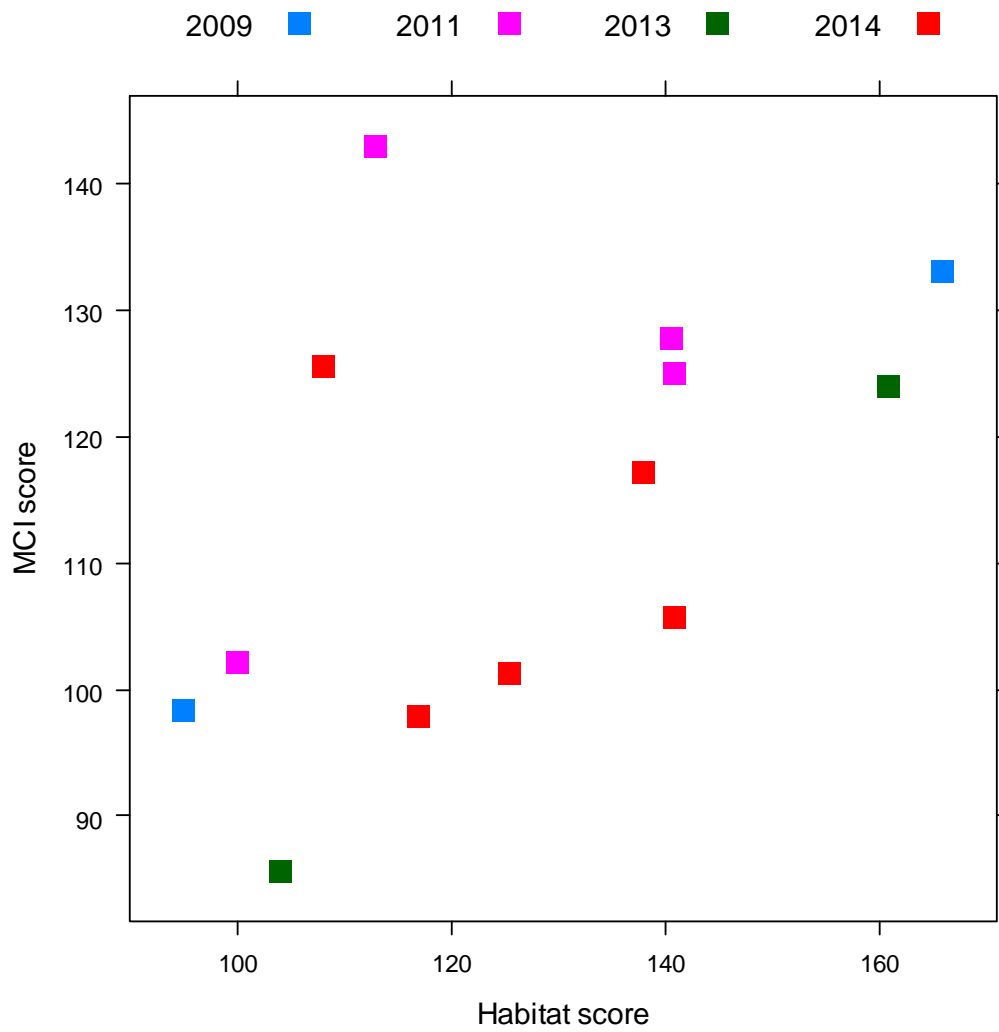


Figure 3-16: Scatterplot of habitat score against MCI score at the Waihou survey sites in different survey years ($\rho=0.49$).

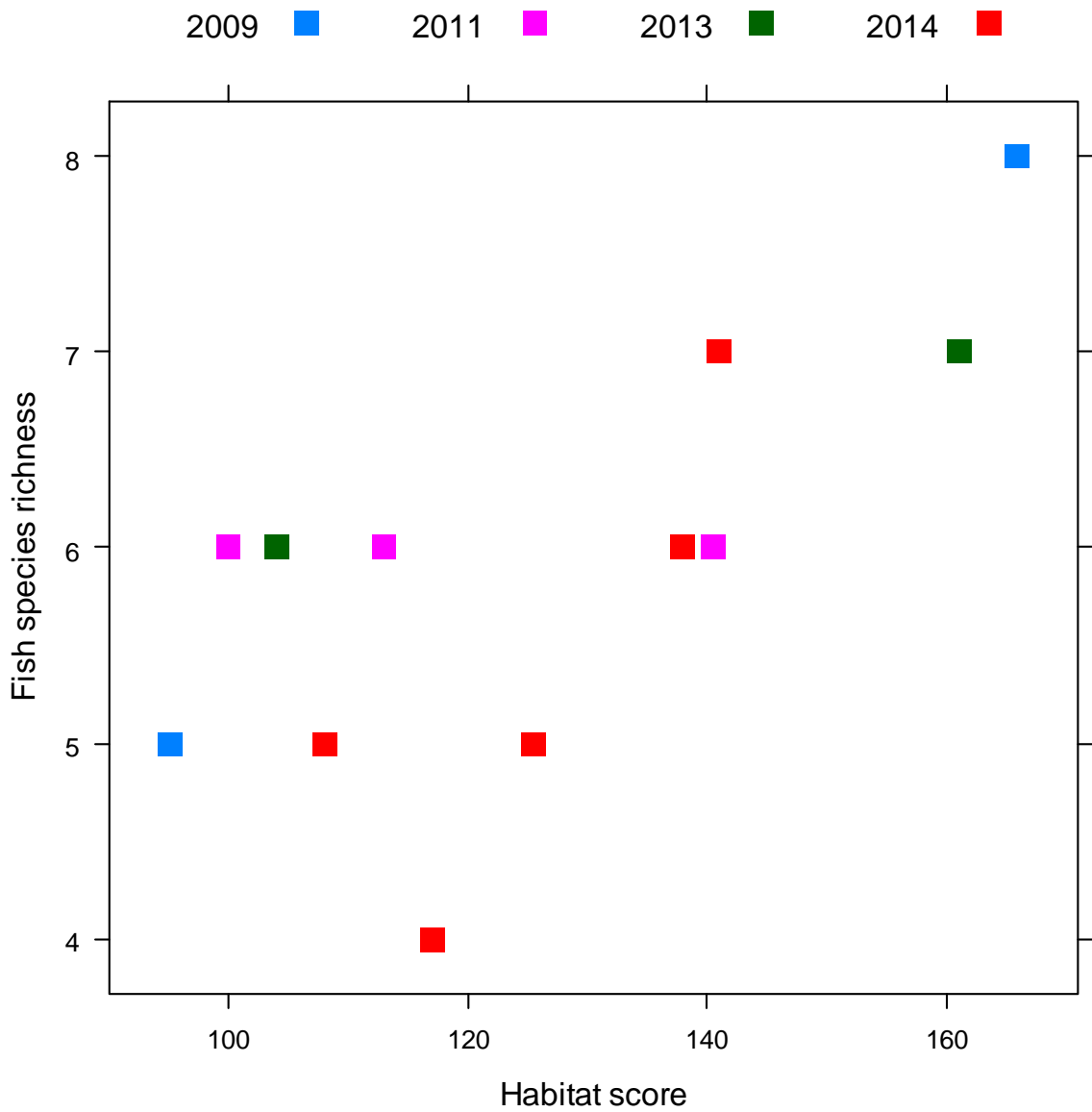


Figure 3-17: Scatterplot of habitat score against fish species richness at the Waihou survey sites in different survey years ($\rho=0.72$).

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 changes to the environment made by humans, e.g., water abstraction, pollutant discharges, land drainage and stream restoration.

Ecological monitoring is essential to understanding ecological status and trends. 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. This survey was the first to encompass all ten sites.

The results of this survey indicate that at the Piako survey sites, the relative abundance of fish was higher in 2014 than in the previous surveys carried out in 2012 and 2013. However, inanga were again 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 2013 and 2014 and hence reduced downstream connectivity. In the case of the Waitoa site, it may also be an indicator of the reduced habitat quality at this site. Macroinvertebrate communities in the Piako were also generally improved in 2014 compared to previous years. In particular, there was a significant improvement in the MCI score at the Piakonui site. This is likely a direct consequence of the channel at this site remaining wetted through the summer of 2013/14, as opposed to drying up as during the drought over the summer of 2012/13. With respect to macrophyte and periphyton communities, the most noticeable changes have been the steady increase in the PEI from 2012 to 2014 at the Waitakaruru site and the significant increase in macrophyte cover at the Waitoa site in 2014.

At the Waiteariki, Paiakarahi and Wairere sites in the Waihou catchment, the abundance of most fish species was generally higher in 2014 than in previous years. However, the relative abundance of both longfin eels and torrentfish in 2014 was lower at the Waiteariki and Wairere sites compared with 2011, when they were previously sampled. Of note was the higher number of banded kokopu captured at the Waiteariki site in 2014 as there are relatively few records of this species from the middle to upper part of the Waihou catchment. The relative abundance of fish in the Karengorengo site was reduced in 2014 compared to previous years. This was largely a result of a high cover of macrophytes which prevented effective sampling of this site in 2014. If macrophyte cover remains this high here, it is likely to compromise the effectiveness of future surveys also. However, this problem is common to many lowland, agricultural streams in the area and therefore is likely to be an issue in any stream representative of this stream type. In general, macroinvertebrate communities were slightly poorer in 2014 compared to previous years, with three of the four sites dropping down a quality class (Excellent to good). It will be important in the future to establish whether this was a

temporary change, or indicative of a long-term trend. Macrophyte cover has progressively increased since 2009 at the Karengorengo site to the point where the majority of the stream is now choked with plants. The PEI at the Paiakarahe site was considerably higher in 2014 compared to previous surveys and was likely one of the main drivers of the decrease in MCI score for the site in 2014.

In both catchments, there are indications that the recruitment of longfin eels is currently relatively poor, with few juveniles captured. In contrast, for shortfin eels there were very few larger female fish captured, perhaps indicating high fishing pressure or poor growth/survival rates for this species. The number of inanga and torrentfish captured during surveys in both catchments has also fallen. However, a good population of banded kokopu remains present in the Mangakahika Stream and was also found in the Waiareke Stream 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. Inanga have also generally only been found in very low numbers at the sites included in this survey, primarily due to a lack of suitable habitat.

There remains a problem regarding reliable differentiation between populations of common and Cran's bullies within the Waihou and Piako catchments and wider Waikato Region. However, to resolve this issue will require a detailed study of these species' genetics, morphology and distribution. This is unlikely to be resolved in the near future and thus it will be necessary to rely on the existing taxonomic key to try and differentiate between species.

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. It is recommended that the same ten sites are monitored annually from now on using the same survey methods. Over time 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 also identify a further group of sites that would be monitored every 3-5 years. This would 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).

5 Conclusions

The process of developing water allocation rules and limits must be robust and transparent (Snelder et al. 2013). The resulting water allocation framework must be sustainable and support adaptive management of water resources. Reliable information on the status and dynamics of instream values is a key component in achieving this.

The NPSFM requires that regional councils set freshwater objectives and associated limits to water resource use that will ensure those objectives are met (MfE 2011). Ecosystem health has been identified as a core national value that must be sustained (MfE 2013). Reliable information on the status and 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 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.
- It would be beneficial for additional physico-chemical variables be collected at each of the sites, e.g., flow, water temperature and water quality, in future. This would allow an 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, Gareth van Assema and Aslan Wright-Stow in completing the fieldwork was greatly appreciated. Brian Smith also provided advice on interpretation of the macroinvertebrate data.

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Appendix A Habitat assessment forms

| Field Assessment Cover Form | | | | | |
|--|-------------------------------|---------------------|---|--------------------|---------------------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | |
| Stream name: Mangakahika Stream | | | Assessor: Paul Franklin | | |
| Site number: 1 | Sample number: | | Date: 14/03/14 | Time: 16:00 | |
| GPS coordinates | | Downstream: | E 1818698 | N 5838814 | |
| | | Upstream: | E 1818618 | N 5838767 | |
| Channel & riparian features | | | Instream hydraulic conditions | | |
| Canopy cover: | | | Estimated or measured reach average: | | |
| Open Partly shaded Very shaded | | | | | |
| Fencing: | Dominant riparian vegetation: | | Stream width (active channel): 1.5 m | | |
| None/ineffective | Crops | Retired vegetation | Stream width (water): 1.5 m | | |
| One side/partial | Pasture | Native shrub | Stream depth: 0.1 m | | |
| Complete | Exotic trees | Native trees | Surface velocity: 0.15 m s ⁻¹ | | |
| Water quality | | | | | |
| Temperature: | 16.0 | °C | Conductivity: | 203.4 | µS cm ⁻¹ |
| Dissolved oxygen: | 90.0 | % | 6.3 | mg l ⁻¹ | |
| Turbidity: | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum | Dimension | Percentage |
| Moderately packed with some overlapping | | | Bedrock | - | |
| Mostly a loose assortment with little overlap | | | Boulder | >256mm | 80 |
| No packing/loose assortment easily moved | | | Cobble | >64-256mm | 20 |
| Embeddedness: | | | Gravel | >2-64mm | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand | >0.06-2mm | |
| <5% | 5-25% | 26-50% | Silt | 0.004-0.06mm | |
| | | | Clay | <0.004mm | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Organic material (% cover) | | | Habitat types sampled | | |
| Large wood (>10cm diameter) | | | (% of effort) | | |
| <5% | 5-25% | 26-50% | Stones: | 100% | |
| | | | Wood: | % | Riffles: 100 % |
| | | | Macrophyte: | % | Runs: % |
| | | | Edges: | % | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Instream plant cover (% streambed area) | | | Number of invertebrates returned: | | |
| Filamentous algae & mats: | | | Koura: | Shrimps: | |
| <5% | 5-25% | 26-50% | Crabs: | Mussels: | |
| | | | Other: | | |
| | | | Mussel type: | | |
| | | | <i>Hyridella</i> | <i>Cucumerunio</i> | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Comments: | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|-------------------------|--|----|----|----|----------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Mangakahika | | | | | | | | | | Site number: 1 | | | | | | | | | | |
| Sample number: | | | | | Assessor: Paul Franklin | | | | | Date: 14/03/14 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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:15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 13 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| 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:15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 13.5 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score:19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | | | | |
|-------------------------------------|--|----|----|----|----|---|---------------------|----|----|----|--|-------------------|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 11 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score:15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held stones Stable substrate Surfaces rough to touch | | | | | <ul style="list-style-type: none"> Periphyton not visible on stones Stable substrate Periphyton obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 133.5 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | | |
|--|--|--|--|---|-------------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Waitoa Stream U/S | | | Assessor: Paul Franklin | | | |
| Site number: 2 | | Sample number: | | Date: 14/03/2014 | Time: 12:35 | |
| GPS coordinates | | Downstream: | | E 1831974 | N 5803819 | |
| | | Upstream: | | E 1831878 | N 5803808 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| <p>Open Partly shaded Very shaded</p> | | | Stream width (active channel): 2.6 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 1.4 m | | |
| None/ineffective | | Crops Retired vegetation | | Stream depth: 0.15 m | | |
| One side/partial | | Pasture Native shrub | | Surface velocity: 0.2 m s ⁻¹ | | |
| Complete | | Exotic trees Native trees | | | | |
| Water quality | | | | | | |
| Temperature: | | 14.2 °C | | Conductivity: 128.8 μS cm ⁻¹ | | |
| Dissolved oxygen: | | 89 % | | 9.2 mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | | |
| Moderately packed with some overlapping | | | Bedrock - | | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm 15 | | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm 70 | | | |
| Embeddedness: | | | Gravel >2-64mm | | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm 15 | | | |
| | | | Clay <0.004mm | | | |
| Organic material (% cover) | | | Habitat types sampled | | | |
| Large wood (>10cm diameter) | | | (% of effort) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: 100% | | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: 100% | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: % Runs: % | | | |
| Fine (<1mm) organic deposits | | | Edges: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | | |
| Instream plant cover (% streambed area) | | | Koura: | | | |
| Filamentous algae & mats: | | | Crabs: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Other: | | | |
| Macrophytes: | | | Mussel type: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | <i>Hyridella</i> | | | |
| Mosses/liverworts: | | | <i>Cucumerunio</i> | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | | | |
| Comments: | | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|----|--|----|----|----|----|---|------------------|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Waitoa Stream U/S | | | | | | | | | | | Site number: 2 | | | | | | | | | |
| Sample number: | | | | | | Assessor: Paul Franklin | | | | | | Date: 14/03/2014 | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:8 | 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 | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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:3 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 3 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:5 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:3 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 4 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 13 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score:16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

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

| Field Assessment Cover Form | | | | | | |
|--|--|-------------------------------|--|--|-------------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Mangapapa Stream | | | Assessor: Joshua Smith | | | |
| Site number: 3 | | Sample number: | | Date: 11/03/2014 | Time: 13:30 | |
| GPS coordinates | | Downstream: | | E 1836783 | N 5809932 | |
| | | Upstream: | | E 1836750 | N 5809802 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| <p>Open Partly shaded Very shaded</p> | | | Stream width (active channel): 4.0 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 3 m | | |
| None/ineffective | | Crops | | Retired vegetation | | |
| One side/partial | | Pasture | | Native shrub | | |
| Complete | | Exotic trees | | Native trees | | |
| | | | Stream depth: 0.25 m | | | |
| | | | Surface velocity: 0.25 m s ⁻¹ | | | |
| Water quality | | | | | | |
| Temperature: | | 18.2 °C | | Conductivity: 120.1 μS cm ⁻¹ | | |
| Dissolved oxygen: | | 79.7 % | | 7.53 mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | | |
| Moderately packed with some overlapping | | | Bedrock - 90 | | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm | | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm | | | |
| Embeddedness: | | | Gravel >2-64mm | | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm 5 | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm 5 | | | |
| | | | Clay <0.004mm | | | |
| Organic material (% cover) | | | Habitat types sampled | | | |
| Large wood (>10cm diameter) | | | (% of effort) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: 100% | | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: 100% | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: % Runs: % | | | |
| Fine (<1mm) organic deposits | | | Edges: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | | |
| Instream plant cover (% streambed area) | | | Koura: common | | | |
| Filamentous algae & mats: | | | Shrimps: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Crabs: | | | |
| Macrophytes: | | | Mussels: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Other: | | | |
| Mosses/liverworts: | | | Mussel type: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Hyridella | | | |
| | | | <i>Cucumerunio</i> | | | |
| Comments: | | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|------------------------|--|----|----|----|----------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Mangapapa Stream | | | | | | | | | | | Site number: 3 | | | | | | | | | |
| Sample number: | | | | | Assessor: Joshua Smith | | | | | Date: 11/03/14 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:8 | 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 | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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 | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 16 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| 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 | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score:16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held stones Stable substrate Surfaces rough to touch | | | | | <ul style="list-style-type: none"> Periphyton not visible on stones Stable substrate Periphyton obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 120 | | | | | | | | | | | | | | | | | | | | |

Field Assessment Cover Form
Wadeable Hard-Bottomed and Soft-Bottomed Streams

| | | | |
|--|-------------------------------|---|---|
| Stream name: Waitakaruru Stream | | Assessor: Joshua Smith | |
| Site number: 4 | Sample number: | Date: 12/03/2014 | Time: 09:30 |
| GPS coordinates | | Downstream: | E 1817745 N 5815748 |
| | | Upstream: | E 1817903 N 5815670 |
| Channel & riparian features | | Instream hydraulic conditions | |
| Canopy cover: | | Estimated or measured reach average: | |
| Open Partly shaded Very shaded | | | |
| Fencing: | Dominant riparian vegetation: | | Stream width (active channel): 3.5 m |
| None/ineffective | Crops | Retired vegetation | Stream width (water): 2.5 m |
| One side/partial | Pasture | Native shrub | Stream depth: 0.25 m |
| Complete | Exotic trees | Native trees | Surface velocity: 0.3 m s ⁻¹ |
| Water quality | | | |
| Temperature: | 15.9 | °C | Conductivity: 130.7 μS cm ⁻¹ |
| Dissolved oxygen: | 66.4 | % | 6.55 mg l ⁻¹ |
| Turbidity: | Clear | Slightly turbid | Highly turbid |
| | | Stained | Other |
| Stream-bottom substrata | | | |
| Compaction (inorganic substrata): | | % surficial inorganic substratum size composition: | |
| Assorted sizes tightly packed &/or overlapping | | Substratum | Dimension |
| Moderately packed with some overlapping | | | Percentage |
| Mostly a loose assortment with little overlap | | Bedrock | - |
| No packing/loose assortment easily moved | | Boulder | >256mm |
| | | Cobble | >64-256mm |
| | | Gravel | >2-64mm |
| | | Sand | >0.06-2mm |
| | | Silt | 0.004-0.06mm |
| | | Clay | <0.004mm |
| Embeddedness: | | | |
| (% gravel-boulder particles covered by fine sediment) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | |
| Organic material (% cover) | | Habitat types sampled | |
| Large wood (>10cm diameter) | | (% of effort) | |
| <5% 5-25% 26-50% 51-75% >75% | | Stones: 100% | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | Wood: % | Riffles: 100% |
| <5% 5-25% 26-50% 51-75% >75% | | Macrophyte: % | Runs: % |
| Fine (<1mm) organic deposits | | Edges: % | |
| <5% 5-25% 26-50% 51-75% >75% | | Number of invertebrates returned: | |
| Instream plant cover (% streambed area) | | Koura: rare | Shrimps: |
| Filamentous algae & mats: | | Crabs: | Mussels: |
| <5% 5-25% 26-50% 51-75% >75% | | Other: | |
| Macrophytes: | | Mussel type: | |
| <5% 5-25% 26-50% 51-75% >75% | | <i>Hyridella</i> | <i>Cucumerunio</i> |
| Mosses/liverworts: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | |
| Comments: Inanga / smelt seen but not caught, only 1 eel seen. | | | |

| deable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|------------------------|--|----|----|----|------------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Waitakaruru Stream | | | | | | | | | | Site number: 4 | | | | | | | | | | |
| Sample number: | | | | | Assessor: Joshua Smith | | | | | Date: 12/03/2014 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 11.5 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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:9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 9.5 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:11 | 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 | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach Channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> • Little/no islands or point bars present • <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> • New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools | | | | | <ul style="list-style-type: none"> • Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> • Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition | | | | |
| Score: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> • 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> • 3 Of 4 velocity/depth regimes present • If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> • 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> • Dominated by 1 velocity/depth regime • Usually deep/slow | | | | |
| Score: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> • >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats • Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover • Must not be new or transient | | | | | <ul style="list-style-type: none"> • 30-50% substrate favourable for invertebrate colonisation • Snags/ submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> • 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> • <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes | | | | |
| Score: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> • Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments | | | | | <ul style="list-style-type: none"> • Periphyton not visible on substrates but obvious to touch | | | | | <ul style="list-style-type: none"> • Periphyton visible • <20% cover of available substrates | | | | | <ul style="list-style-type: none"> • Periphyton obvious & prolific • >20% cover of available substrates | | | | |
| Score: 9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 98.5 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | | |
|--|--|-------------------------------|--|---|-------------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Piakonui Stream | | | Assessor: Joshua Smith | | | |
| Site number: 5 | | Sample number: | | Date: 11/03/14 | Time: 15:30 | |
| GPS coordinates | | Downstream: | | E 1831211 | N 5815768 | |
| | | Upstream: | | E 1831210 | N 5809980 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| Open Partly shaded Very shaded | | | Stream width (active channel): 8 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 3.5 m | | |
| None/ineffective | | Crops | | Retired vegetation | | |
| One side/partial | | Pasture | | Native shrub | | |
| Complete | | Exotic trees | | Native trees | | |
| | | | Stream depth: 0.30 m | | | |
| | | | Surface velocity: 0.30 m s ⁻¹ | | | |
| Water quality | | | | | | |
| Temperature: | | 13.1 °C | | Conductivity: 88.7 μS cm ⁻¹ | | |
| Dissolved oxygen: | | 57.4 % | | 6.01 mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | | % surficial inorganic substratum size composition: | | |
| Assorted sizes tightly packed &/or overlapping | | | | Substratum Dimension Percentage | | |
| Moderately packed with some overlapping | | | | Bedrock - - | | |
| Mostly a loose assortment with little overlap | | | | Boulder >256mm 40 | | |
| No packing/loose assortment easily moved | | | | Cobble >64-256mm 25 | | |
| Embeddedness: | | | | Gravel >2-64mm 10 | | |
| (% gravel-boulder particles covered by fine sediment) | | | | Sand >0.06-2mm 5 | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Silt 0.004-0.06mm 20 | | |
| | | | | Clay <0.004mm - | | |
| Organic material (% cover) | | | | Habitat types sampled | | |
| Large wood (>10cm diameter) | | | | (% of effort) | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Stones: 100% | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | | Wood: % Riffles: 100% | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Macrophyte: % Runs: % | | |
| Fine (<1mm) organic deposits | | | | Edges: % | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Number of invertebrates returned: | | |
| Instream plant cover (% streambed area) | | | | Koura: | | |
| Filamentous algae & mats: | | | | Shrimps: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Crabs: | | |
| Macrophytes: | | | | Mussels: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | Other: | | |
| Mosses/liverworts: | | | | Mussel type: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | <i>Hyridella</i> | | |
| Comments: | | | | <i>Cucumerunio</i> | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|----------------------|--|----|----|----|------------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Piakonui Stream | | | | | | | | | | | Site number: 5 | | | | | | | | | |
| Sample number: | | | | | Assessor: Josh Smith | | | | | Date: 11/03/2014 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:19 | 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 | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| Left bank:19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 18 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 18 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| 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 | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach Channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score: 19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 11 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 11 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments | | | | | <ul style="list-style-type: none"> Periphyton not visible on substrates but obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 138.5 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | | |
|--|--|--|---|---|-------------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Paiakarahi Stream D/S | | | Assessor: Paul Franklin | | | |
| Site number: 6 | | Sample number: | | Date: 13/03/2014 | Time: 11:50 | |
| GPS coordinates | | Downstream: | | E 1841027 | N 5867879 | |
| | | Upstream: | | E 1841098 | N 5867799 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| Open Partly shaded Very shaded | | | Stream width (active channel): 6 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 3 m | | |
| None/ineffective | | Crops Retired vegetation | | Stream depth: 0.25 m | | |
| One side/partial | | Pasture Native shrub | | Surface velocity: 0.3 m s ⁻¹ | | |
| Complete | | Exotic trees Native trees | | | | |
| Water quality | | | | | | |
| Temperature: | | 15.9 °C | | Conductivity: 113.7 μS cm ⁻¹ | | |
| Dissolved oxygen: | | 97 % | | 9.6 mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | | |
| Moderately packed with some overlapping | | | Bedrock - | | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm 70 | | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm 30 | | | |
| Embeddedness: | | | Gravel >2-64mm | | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm | | | |
| | | | Clay <0.004mm | | | |
| Organic material (% cover) | | | Habitat types sampled | | | |
| Large wood (>10cm diameter) | | | (% of effort) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: 100% | | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: 100 % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: % Runs: % | | | |
| Fine (<1mm) organic deposits | | | Edges: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | | |
| Instream plant cover (% streambed area) | | | Koura: | | | |
| Filamentous algae & mats: | | | Crabs: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Other: | | | |
| Macrophytes: | | | Mussel type: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | <i>Hyridella</i> | | | |
| Mosses/liverworts: | | | <i>Cucumerunio</i> | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | | | |
| Comments: | | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|-------------------------|--|----|----|----|----------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Paikarahi Stream D/S | | | | | | | | | | | Site number: 6 | | | | | | | | | |
| Sample number: | | | | | Assessor: Paul Franklin | | | | | Date: 13/03/14 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| Left bank:20 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:20 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 20 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| Left bank:17 | 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: 17.5 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| 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:16 | 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 | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach Channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held substrates (macrophytes, wood etc.) or fine sediments | | | | | <ul style="list-style-type: none"> Periphyton not visible on substrates but obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 6 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE:141 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | | |
|---|--|-------------------------------|---|---|-------------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Karengorengo Stream | | | Assessor: Joshua Smith | | | |
| Site number: 7 | | Sample number: | | Date: 10/03/14 | Time: 08:00 | |
| GPS coordinates | | Downstream: | | E 1848393 | N 5823235 | |
| | | Upstream: | | E 1848423 | N 5823099 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| <p>Open Partly shaded Very shaded</p> | | | Stream width (active channel): 4 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 2.5 m | | |
| None/ineffective | | Crops | | Retired vegetation | | |
| One side/partial | | Pasture | | Native shrub | | |
| Complete | | Exotic trees | | Native trees | | |
| | | | Stream depth: 0.5 m | | | |
| | | | Surface velocity: 0.35 m s ⁻¹ | | | |
| Water quality | | | | | | |
| Temperature: | | 13.9 °C | | Conductivity: 131.4 μS cm ⁻¹ | | |
| Dissolved oxygen: | | 73.4 % | | 7.58 mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | | |
| Moderately packed with some overlapping | | | Bedrock - | | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm | | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm | | | |
| Embeddedness: | | | Gravel >2-64mm 10 | | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm 85 | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm 5 | | | |
| | | | Clay <0.004mm | | | |
| Organic material (% cover) | | | Habitat types sampled | | | |
| Large wood (>10cm diameter) | | | (% of effort) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: % | | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: 100% Runs: 100% | | | |
| Fine (<1mm) organic deposits | | | Edges: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | | |
| Instream plant cover (% streambed area) | | | Koura: Abundant Shrimps: Common | | | |
| Filamentous algae & mats: | | | Crabs: Mussels: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Other: | | | |
| Macrophytes: | | | Mussel type: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | <i>Hyridella</i> <i>Cucumerunio</i> | | | |
| Mosses/liverworts: | | | | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | | | |

| Wadeable Soft-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|------------------------|--|----|----|----|----------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Karengorengo Stream | | | | | | | | | | Site number: 7 | | | | | | | | | | |
| Sample number: | | | | | Assessor: Joshua Smith | | | | | Date: 10/03/14 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| Left bank:8 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:8 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 8 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| Left bank:8 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:8 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean:8 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 12 | | | | | | | | | | | | | | | | | | | | |
| 4. Channel sinuosity | <ul style="list-style-type: none"> Bends increase stream length 3-4 times longer than if it was straight | | | | | <ul style="list-style-type: none"> Bends increase stream length 2-3 times longer than if it was straight | | | | | <ul style="list-style-type: none"> Bends increase stream length 1-2 times longer than if it was straight | | | | | <ul style="list-style-type: none"> Channel straight | | | | |
| Score: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted 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 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | | | | |
|-------------------------------------|--|----|----|----|----|---|---------------------|----|----|----|--|-------------------|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score:14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Pool variability | <ul style="list-style-type: none"> Pools evenly mixed Large/shallow, large/deep, small/shallow, small/deep | | | | | <ul style="list-style-type: none"> Majority of pools large/deep Very few shallow pools | | | | | <ul style="list-style-type: none"> Prevalence of shallow pools | | | | | <ul style="list-style-type: none"> Majority of pools small/shallow | | | | |
| Score: 13 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held stones Stable substrate Surfaces rough to touch | | | | | <ul style="list-style-type: none"> Periphyton not visible on stones Stable substrate Periphyton obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 117 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | | |
|--|--|-------------------------------|--|---|-----------|-------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | | |
| Stream name: Wairere Stream | | | Assessor: Kathryn Julian | | | |
| Site number: 8 | | Sample number: | | Date: 10/03/2014 | Time: | |
| GPS coordinates | | Downstream: | | E 1831968 | N 5803870 | |
| | | Upstream: | | E 1831878 | N 5803808 | |
| Channel & riparian features | | | Instream hydraulic conditions | | | |
| Canopy cover: | | | Estimated or measured reach average: | | | |
| Open Partly shaded Very shaded | | | Stream width (active channel): 5.6 m | | | |
| Fencing: | | Dominant riparian vegetation: | | Stream width (water): 4.5 m | | |
| None/ineffective | | Crops | | Retired vegetation | | |
| One side/partial | | Pasture | | Native shrub | | |
| Complete | | Exotic trees | | Native trees | | |
| | | | Stream depth: 0.3 m | | | |
| | | | Surface velocity: 0.3 m s ⁻¹ | | | |
| Water quality | | | | | | |
| Temperature: | | 18.2 °C | | Conductivity: 62.6 μS cm ⁻¹ | | |
| Dissolved oxygen: | | NA % | | NA mg l ⁻¹ | | |
| Turbidity: | | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | | |
| Moderately packed with some overlapping | | | Bedrock - - | | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm 70 | | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm 15 | | | |
| Embeddedness: | | | Gravel >2-64mm 5 | | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm 5 | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm 5 | | | |
| | | | Clay <0.004mm - | | | |
| Organic material (% cover) | | | Habitat types sampled | | | |
| Large wood (>10cm diameter) | | | (% of effort) | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: 100% | | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: 100% | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: % Runs: % | | | |
| Fine (<1mm) organic deposits | | | Edges: % | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | | |
| Instream plant cover (% streambed area) | | | Koura: common Shrimps: common | | | |
| Filamentous algae & mats: | | | Crabs: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Mussels: | | | |
| Macrophytes: | | | Other: | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Mussel type: | | | |
| Mosses/liverworts: | | | <i>Hyridella</i> <i>Cucumerunio</i> | | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|--------------------------|--|----|----|----|------------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Wairere stream | | | | | | | | | | Site number: 8 | | | | | | | | | | |
| Sample number: | | | | | Assessor: Kathryn Julian | | | | | Date: 10/03/2014 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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 | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 17 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score:17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held stones Stable substrate Surfaces rough to touch | | | | | <ul style="list-style-type: none"> Periphyton not visible on stones Stable substrate Periphyton obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 6 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE 125.5 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | |
|---|-------------------------------|---------------------|---|--------------------|---------------------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | |
| Stream name: Waiteariki stream | | | Assessor: Joshua Smith | | |
| Site number: 9 | Sample number: | | Date: 11/03/14 | Time: 09:30 | |
| GPS coordinates | | Downstream: | E 1852566 | N 5818150 | |
| | | Upstream: | E 1852697 | N 5818212 | |
| Channel & riparian features | | | Instream hydraulic conditions | | |
| Canopy cover: | | | Estimated or measured reach average: | | |
| Open | | Partly shaded | Very shaded | | |
| Fencing: | Dominant riparian vegetation: | | Stream width (active channel): 20 m | | |
| None/ineffective | Crops | Retired vegetation | Stream width (water): 5 m | | |
| One side/partial | Pasture | Native shrub | Stream depth: 0.35 m | | |
| Complete | Exotic trees | Native trees | Surface velocity: 0.20 m s ⁻¹ | | |
| Water quality | | | | | |
| Temperature: | 13.6 | °C | Conductivity: | 44.8 | µS cm ⁻¹ |
| Dissolved oxygen: | 99.7 | % | 10.38 | mg l ⁻¹ | |
| Turbidity: | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum | Dimension | Percentage |
| Moderately packed with some overlapping | | | Bedrock | - | |
| Mostly a loose assortment with little overlap | | | Boulder | >256mm | 85 |
| No packing/loose assortment easily moved | | | Cobble | >64-256mm | 10 |
| Embeddedness: | | | Gravel | >2-64mm | 5 |
| (% gravel-boulder particles covered by fine sediment) | | | Sand | >0.06-2mm | |
| <5% | 5-25% | 26-50% | Silt | 0.004-0.06mm | |
| | | | Clay | <0.004mm | |
| | | | | | |
| Organic material (% cover) | | | Habitat types sampled | | |
| Large wood (>10cm diameter) | | | (% of effort) | | |
| <5% | 5-25% | 26-50% | Stones: | 80% | |
| | | | Wood: | % | Riffles: 50% |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Macrophyte: | % | Runs: 50% |
| <5% | 5-25% | 26-50% | Edges: | 20% | |
| | | | Number of invertebrates returned: | | |
| Fine (<1mm) organic deposits | | | Koura: | Shrimps: | |
| <5% | 5-25% | 26-50% | Crabs: | Mussels: | |
| | | | Other: | | |
| Macrophytes: | | | Mussel type: | | |
| <5% | 5-25% | 26-50% | <i>Hyridella</i> | <i>Cucumerunio</i> | |
| | | | | | |
| Mosses/liverworts: | | | | | |
| <5% | 5-25% | 26-50% | | | |
| | | | | | |
| Comments: | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|------------------------|--|----|----|----|------------------|---|---|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Waiteariki Stream | | | | | | | | | | Site number: 9 | | | | | | | | | | |
| Sample number: | | | | | Assessor: Joshua Smith | | | | | Date: 11/03/2014 | | | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 12.5 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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:5 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 11.5 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| 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:14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 16 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| 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 | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach Channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted 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 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held substrates (macrophytes, wood etc.) or fine sediments | | | | | <ul style="list-style-type: none"> Periphyton not visible on substrates but obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 138 | | | | | | | | | | | | | | | | | | | | |

| Field Assessment Cover Form | | | | | |
|---|-------------------------------|--------------------|---|--------------------|---------------------|
| Wadeable Hard-Bottomed and Soft-Bottomed Streams | | | | | |
| Stream name: Waitawheta River | | | Assessor: Paul Franklin | | |
| Site number: 10 | Sample number: | | Date: 13/03/2014 | Time: 16:30 | |
| GPS coordinates | | Downstream: | E 1845480 | N 5849662 | |
| | | Upstream: | E 1845388 | N 5849622 | |
| Channel & riparian features | | | Instream hydraulic conditions | | |
| Canopy cover: | | | Estimated or measured reach average: | | |
| Open | | Partly shaded | Very shaded | | |
| Fencing: | Dominant riparian vegetation: | | Stream width (active channel): 5.0m | | |
| None/ineffective | Crops | Retired vegetation | Stream width (water): 3.0m | | |
| One side/partial | Pasture | Native shrub | Stream depth: 0.1m | | |
| Complete | Exotic trees | Native trees | Surface velocity: 0.2m s ⁻¹ | | |
| Water quality | | | | | |
| Temperature: | 17.1 | °C | Conductivity: | 73.4 | µS cm ⁻¹ |
| Dissolved oxygen: | 106.8 | % | 9.95 | mg l ⁻¹ | |
| Turbidity: | Clear | Slightly turbid | Highly turbid | Stained | Other |
| Stream-bottom substrata | | | | | |
| Compaction (inorganic substrata): | | | % surficial inorganic substratum size composition: | | |
| Assorted sizes tightly packed &/or overlapping | | | Substratum Dimension Percentage | | |
| Moderately packed with some overlapping | | | Bedrock - | | |
| Mostly a loose assortment with little overlap | | | Boulder >256mm 80 | | |
| No packing/loose assortment easily moved | | | Cobble >64-256mm 15 | | |
| Embeddedness: | | | Gravel >2-64mm 5 | | |
| (% gravel-boulder particles covered by fine sediment) | | | Sand >0.06-2mm | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Silt 0.004-0.06mm | | |
| | | | Clay <0.004mm | | |
| Organic material (% cover) | | | Habitat types sampled | | |
| Large wood (>10cm diameter) | | | (% of effort) | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Stones: 100% | | |
| Coarse detritus (small wood, sticks, leaves etc., >1mm) | | | Wood: % Riffles: 100 % | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Macrophyte: % Runs: % | | |
| Fine (<1mm) organic deposits | | | Edges: % | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Number of invertebrates returned: | | |
| Instream plant cover (% streambed area) | | | Koura: | | |
| Filamentous algae & mats: | | | Shrimps: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Crabs: | | |
| Macrophytes: | | | Mussels: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | Other: | | |
| Mosses/liverworts: | | | Mussel type: | | |
| <5% 5-25% 26-50% 51-75% >75% | | | | | |
| Comments: | | | | | |

| Wadeable Hard-Bottomed Streams | | | | | | | | | | | | | | | | | | | | |
|---|--|----|----|----|----|--|----|----|----|----|---|------------------|---|---|---|---|---|---|---|---|
| Qualitative Habitat Assessment Field Data Sheet | | | | | | | | | | | | | | | | | | | | |
| Stream name: Waitawheta River | | | | | | | | | | | Site number: 10 | | | | | | | | | |
| Sample number: | | | | | | Assessor: Kathryn Julian | | | | | | Date: 13/03/2014 | | | | | | | | |
| Habitat parameter | Category | | | | | | | | | | | | | | | | | | | |
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | |
| 1. Riparian vegetative zone width | <ul style="list-style-type: none"> Bankside vegetation buffer >10m Continuous & dense | | | | | <ul style="list-style-type: none"> Bankside vegetation buffer is <10m Mostly continuous | | | | | <ul style="list-style-type: none"> Pathways present and/or stock Mostly healed over | | | | | <ul style="list-style-type: none"> Breaks frequent Human activity obvious | | | | |
| 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:6 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 4.5 | | | | | | | | | | | | | | | | | | | | |
| 2. Vegetative protection | <ul style="list-style-type: none"> Bank surfaces & immediate riparian zones covered by native vegetation Trees, under-storey shrubs or non-woody plants present Vegetative disruption minimal | | | | | <ul style="list-style-type: none"> Bank surfaces covered mainly by native vegetation Disruption evident Banks may be covered by exotic forestry | | | | | <ul style="list-style-type: none"> Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species Vegetation disruption obvious Bare soil/closely cropped vegetation common | | | | | <ul style="list-style-type: none"> Bank surfaces covered by grasses & shrubs Disruption of stream bank vegetation very high Grass heavily grazed Significant stock damage to bank | | | | |
| 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:7 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 5.5 | | | | | | | | | | | | | | | | | | | | |
| 3. Bank stability | <ul style="list-style-type: none"> Banks stable Erosion/bank failure absent/minimal <5% of bank affected | | | | | <ul style="list-style-type: none"> Moderately stable Infrequent, small areas of erosion mostly healed over 5-30% of bank eroded | | | | | <ul style="list-style-type: none"> Moderately unstable 30-60% of bank in reach has areas of erosion High erosion potential during floods | | | | | <ul style="list-style-type: none"> Unstable Many eroded areas 60-100% of bank has erosional scars | | | | |
| Left bank:13 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Right bank:13 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Mean: 13 | | | | | | | | | | | | | | | | | | | | |
| 4. Frequency of riffles | <ul style="list-style-type: none"> Riffles relatively frequent Distance between riffles divided by stream width=5-7 Variety of habitat is key | | | | | <ul style="list-style-type: none"> Occurrence of riffles infrequent Distance between riffles divided by stream width=7-15 | | | | | <ul style="list-style-type: none"> Occasional riffle or run Bottom contours provide some habitat Distance between riffles divided by stream width=15-25 | | | | | <ul style="list-style-type: none"> Generally flat water, shallow riffles Poor habitat Distance between riffles divided by stream width=>25 | | | | |
| Score: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 5. Channel alteration | <ul style="list-style-type: none"> Changes to channel/dredging absent/minimal Stream with normal pattern | | | | | <ul style="list-style-type: none"> Some changes to channel/dredging Evidence of past channel/dredging Recent channel/dredging not present | | | | | <ul style="list-style-type: none"> Channel changes/dredging extensive Embankments/shoring structures present on both banks 40-80% of reach channelized & disrupted | | | | | <ul style="list-style-type: none"> Banks shored with gabion/cement >80% of stream reach channelized or disrupted Instream habitat altered/absent | | | | |
| Score:19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| Habitat parameter | Category Optimal | | | | | Habitat parameter | | | | | Category Optimal | | | | | Habitat parameter | | | | |
|-------------------------------------|--|----|----|----|----|---|----|----|----|----|--|---|---|---|---|---|---|---|---|---|
| 6. Sediment deposition | <ul style="list-style-type: none"> Little/no islands or point bars present <20% of bottom affected by sediment deposition | | | | | <ul style="list-style-type: none"> New increase in bar formation, mostly from gravel, sand or fine sediment 20-50% of bottom affected Slight deposition in pools | | | | | <ul style="list-style-type: none"> Some deposition of new gravel, sand or fine sediment on old & new bars 50-80% of bottom affected Sediment deposits at obstructions, constrictions & bends | | | | | <ul style="list-style-type: none"> Heavy deposits of fine material Increased bar development >80% of bottom changing frequently Pools almost absent due to sediment deposition | | | | |
| Score: 19 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7. Velocity/depth regimes | <ul style="list-style-type: none"> 4 velocity/depth regimes present Slow/deep, slow/shallow, fast/shallow, fast/deep | | | | | <ul style="list-style-type: none"> 3 Of 4 velocity/depth regimes present If fast/shallow is missing then score lower | | | | | <ul style="list-style-type: none"> 2 of 4 velocity/depth regimes present If fast/shallow or slow/shallow are missing, score low | | | | | <ul style="list-style-type: none"> Dominated by 1 velocity/depth regime Usually deep/slow | | | | |
| Score: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 8. Abundance & diversity of habitat | <ul style="list-style-type: none"> >50% substrate favourable for invertebrate colonisation & wide variety of woody debris, riffles, root mats Snags/ submerged logs/undercut banks/cobbles provides abundant fish cover Must not be new or transient | | | | | <ul style="list-style-type: none"> 30-50% substrate favourable for invertebrate colonisation Snags/ submerged logs/undercut banks/cobbles Fish cover common Moderate variety of habitat types. Can consist of some new material | | | | | <ul style="list-style-type: none"> 10-30% substrate favourable for invertebrate colonisation Fish cover patchy 60-90% substrate easily moved by foot Woody debris rare or may be smothered by sediment | | | | | <ul style="list-style-type: none"> <10% substrate favourable for invertebrate colonisation Fish cover rare or absent Substrate unstable or lacking Stable habitats lacking or limited to macrophytes | | | | |
| Score:13 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9. Periphyton | <ul style="list-style-type: none"> Periphyton not evident on hand held stones Stable substrate Surfaces rough to touch | | | | | <ul style="list-style-type: none"> Periphyton not visible on stones Stable substrate Periphyton obvious to touch | | | | | <ul style="list-style-type: none"> Periphyton visible <20% cover of available substrates | | | | | <ul style="list-style-type: none"> Periphyton obvious & prolific >20% cover of available substrates | | | | |
| Score: 8 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| TOTAL SCORE: 108 | | | | | | | | | | | | | | | | | | | | |

Appendix B Fish surveys

| Fish collection form – Wadeable streams/ivers | | | | | | | | | | | | | | | | | | | | | |
|---|--|----------------------------|---|--|---|--------------------------------|---|--------------------------|---|------------------------|-------|-----------------------|--------------|----------------------------|-------|-------|-------|------------------------|-------|------------------------|--|
| Team members: Paul Franklin (NIWA) Mike Martin (NIWA) Gareth van Assema (NIWA) | | | | GPS (d/s): E2728975 N6400407 GPS (u/s): E2728895 N6400360 | | | | Site: Mangakahika Stream | | | | | | Date: 14/03/2014 | | | | | | | |
| | | | | Not fished | | Fished none collected | | Fished 10 sub-reaches | | Fished 5-9 sub-reaches | | Fished <5 sub-reaches | | FLAG for fished/not fished | | | | | | | |
| Fish sample id: | | Total shock time (min): 61 | | Fishing time: Start 14:10 Finish 16:00 | | Sample distance (m): 150 | | Wetted width (m): | | A 1.3 | C 1.0 | E 1.0 | G 2.2 | I 2.4 | B 1.7 | D 1.3 | F 1.4 | H 1.4 | J 1.5 | | |
| Sampling gear: | | Spotlight | | EFM | | Seine | | Length (m) | | Water visibility: | | Good | | Average | | Poor | | Water temp. (°C): 16.0 | | Conductivity (µS): 203 | |
| EFM anode: | | Big | | EFM volts (x100): 3 | | EFM pulse rate (Hz or pps): 60 | | EFM pulse width (ms): 2 | | Spotlight (watts): | | | | | | | | | | | |
| Species | | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG | | | | | |
| | | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | | | | | | |
| Banded Kokopu | | 1 | 2 | 4 | 3 | 3 | 1 | 3 | 6 | | 2 | 26 | | 64 | 155 | | | | | | |
| Shortfin Eel | | | 5 | 5 | 3 | 2 | 3 | 3 | 2 | 6 | 1 | 30 | | 70 | 350 | | | | | | |
| Longfin Eel | | 1 | | | 1 | | | 1 | | 2 | 3 | 8 | | 163 | 820 | | | | | | |
| Common Bully | | 2 | 3 | 3 | 1 | 2 | 2 | | 3 | 2 | 3 | 21 | | 30 | 63 | | | | | | |
| Koura | | 3 | | 1 | | 1 | 2 | | | | | 8 | | | | | | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Paul Franklin (NIWA) Mike Martin (NIWA) Gareth van Assema (NIWA) | | GPS (d/s): E 1831974 N 5803819 | | Site: Waitoa Stream U/S | | | | Date: 14/03/2014 | | | | | | | |
|---|--|--------------------------------|--------------------------------|--------------------------|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|------------------------|-------------|--------------|-------------|------|------|
| | | GPS (u/s): E 1831878 N 5803808 | | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | |
| Fish sample id: | Total shock time (min): 73 | Fishing time: | Start 10:15 Finish 12:15 | Sample distance (m): 150 | Wetted width (m): | A 0.7 B 2.1 | C 2.0 D 1.0 | E 1.1 F 1.5 | G 1.7 H 2.7 | I 1.7 J 2.0 | | | | | |
| Sampling gear: | Spotlight | EFM | Seine | Length (m) Mesh (mm) | Water visibility: | Good | Average | Poor | Water temp. (°C): 14.2 | Conductivity (µS): 129 | | | | | |
| EFM anode: | Big Small | EFM volts (x100): 3 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Shortfin eel | 9 | 16 | 15 | 15 | 8 | 15 | 3 | 11 | 9 | 13 | 114 | | 91 | 395 | |
| Cran's bully | 10 | 25 | 28 | 13 | 7 | 6 | 2 | 6 | 9 | 27 | 133 | | 20 | 85 | |
| Longfin eel | 2 | | | | 1 | | 2 | 1 | | | 6 | | 275 | 880 | |
| Koura | 1 | 7 | 7 | 5 | | 10 | 10 | 4 | 10 | 13 | 67 | | | | |
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| FLAG | Comment | | | | | | | FLAG | Comment | | | | | | |
| F1 | Final 5 m of section J not fished because of deep pool | | | | | | | | | | | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Joshua Smith Rimutere Wharakura Kathryn Julian, Aslan Wright-Stow | | GPS (d/s): E 1836783 N 5809932 | | Site: Mangapapa Stream | | | | Date: 11/03/2014 | | | | | | | |
|--|----------------------------|--------------------------------|--------------------------------|--------------------------|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|------------------------|-------------|--------------|-------------|------|------|
| | | GPS (u/s): E 1836750 N 5809802 | | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | |
| Fish sample id: | Total shock time (min): 75 | Fishing time: | Start 13:10 Finish 15:20 | Sample distance (m): 150 | Wetted width (m): | A 3.0 B 3.2 | C 4.3 D 4.5 | E 5.0 F 3.6 | G 4.6 H 3.2 | I 2.8 J 2.9 | | | | | |
| Sampling gear: | Spotlight | EFM | Seine | Length (m) Mesh (mm) | Water visibility: | Good | Average | Poor | Water temp. (°C): 18.2 | Conductivity (µS): 120 | | | | | |
| EFM anode: | Big Small | EFM volts (x100): 3 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Cran's bully | 5 | 13 | 21 | 13 | 12 | 9 | 8 | 10 | 3 | | 94 | | 15 | 65 | |
| Shortfin eel | | 4 | 6 | 4 | 4 | 1 | 3 | 4 | | | 26 | | 90 | 610 | |
| Longfin eel | | 1 | | | | | | | 1 | 1 | 3 | | 500 | 700 | |
| Koura | | 5 | 8 | 8 | | 2 | 2 | 1 | 2 | 3 | 31 | | | | |
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Fish collection form – Wadeable streams/ivers

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| Team members: Kathryn Julian Joshua Smith Rimu Wharakura | | GPS (d/s): E 1817745 N 5815748 | Site: Waitakaruru Stream | | | | Date: 12/03/2014 | | | | | | | | |
| | | GPS (u/s): E 1817903 N 5815670 | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | | |
| Fish sample id: | Total shock time (min): 53 | Fishing time: Start 08:30 Finish 11:25 | Sample distance (m): 150 | Wetted width (m): | | A 2.1 C 1.7 E 2.4 G 1.9 I 2.2 | | | | | | | | | |
| Sampling gear: Spotlight EFM Seine | | Length (m) | Water visibility: Good Average Poor | | Water temp. (°C): 15.9 | | Conductivity (µS): 131 | | | | | | | | |
| EFM anode: Big Small | | EFM volts (x100): 3 | EFM pulse rate (Hz or pps): 60 | | EFM pulse width (ms): 2 | | Spotlight (watts): | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Shortfin eel | 7 | 7 | 6 | 8 | 8 | 10 | 10 | 15 | 7 | 10 | 88 | | 90 | 700 | |
| Longfin eel | 1 | | | 4 | 1 | 1 | 2 | | 1 | | 10 | | 90 | 740 | |
| Cran's bully | 4 | | 14 | 10 | 25 | 4 | 22 | 10 | 13 | 2 | 104 | | 21 | 57 | |
| Torrentfish | | | | | 1 | | | | | | 1 | | 95 | 95 | |
| Elver | | | | | | | 7 | 2 | 2 | 1 | 12 | | | | |
| Koura | | 1 | 5 | 2 | 1 | 3 | 11 | 8 | 1 | 6 | 38 | | | | |
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| FLAG | Comment | | | | | | | FLAG | Comment | | | | | | |
| F1 | Difficult to fish reach B due to macrophyte cover | | | | | | | | | | | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Joshua Smith Aslan Wright-Stow Rimu Wharakura, Kerry Costley | | GPS (d/s): E 1831211 N 5815768 | Site: Piakonui Stream U/S | | | | Date: 11/03/2014 | | | | | | | | | |
|---|----------------------------|--------------------------------|--------------------------------|--------------------------|-----------------------|------------------------|-----------------------|----------------------------|------------------------|-----------------------|-------------|--------------|-------------|------|------|--|
| | | GPS (u/s): E 1831210 N 5809980 | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | | | |
| Fish sample id: | Total shock time (min): NA | Fishing time: | Start 15:30 Finish NA | Sample distance (m): 150 | Wetted width (m): | A 3.5 B 1.8 | C 2.8 D 1.7 | E 3.0 F 2.1 | G 2.4 H 2.2 | I 3.0 J 2.3 | | | | | | |
| Sampling gear: | Spotlight | EFM | Seine | Length (m) Mesh (mm) | Water visibility: | Good | Average | Poor | Water temp. (°C): 13.1 | Conductivity (µS): 89 | | | | | | |
| EFM anode: | Big Small | EFM volts (x100): 3 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG | |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | | |
| Longfin eel | 1 | 1 | | 2 | | | | | | | 4 | | 400 | 650 | | |
| Common bully | | | | 1 | | 1 | 4 | | 3 | 13 | 22 | | 30 | 87 | | |
| Shortfin eel | 1 | | | | | 2 | 1 | | 1 | 2 | 7 | | 105 | 185 | | |
| Banded kokopu | | | | | | | | | | 4 | 4 | | 100 | 205 | | |
| Koura | 29 | 12 | 18 | 20 | 29 | 15 | 14 | 14 | 7 | 29 | 200 | | | | | |
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Fish collection form – Wadeable streams/ivers

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| Team members: Paul Franklin Kathryn Julian Rimu Wharakura | | GPS (d/s): E 1841027 N 5867879 | Site: Paiakarahi Stream D/S | | | | Date: 13/03/2014 | | | | | | | | |
| | | GPS (u/s): E 1841098 N 5867799 | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | | |
| Fish sample id: | Total shock time (min): 56 | Fishing time: Start 09:55 Finish 11:50 | Sample distance (m): 150 | Wetted width (m): | | A 2.4 C 4.2 E 4.2 G 3.2 I 5.3 | | | | | | | | | |
| Sampling gear: Spotlight EFM Seine | | Length (m) | Water visibility: Good Average Poor | | Water temp. (°C): 15.9 | | Conductivity (µS): 114 | | | | | | | | |
| EFM anode: Big Small | | EFM volts (x100): 4 | EFM pulse rate (Hz or pps): 60 | | EFM pulse width (ms): 2 | | Spotlight (watts): | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Cran's bully | 8 | 2 | 4 | 6 | 5 | 4 | 9 | 9 | 7 | 10 | 64 | | 20 | 70 | |
| Shortfin eel | | | 1 | | 1 | | 3 | | 1 | 1 | 7 | | 86 | 190 | |
| Longfin eel | 1 | | 4 | | 1 | | 2 | | | | 8 | | 98 | 1002 | |
| Rainbow trout | | | | | | | | | 2 | 1 | 3 | | 150 | 156 | |
| Banded kokopu | | | | | | | 1 | | | | 1 | | 158 | 158 | |
| Inanga | | | | | | 1 | | | | | 1 | | 90 | 90 | |
| Torrentfish | 1 | | | | 1 | | 2 | | | 1 | 5 | | 55 | 105 | |
| Koura | | 2 | 6 | 5 | 2 | 1 | 5 | 2 | 1 | 8 | 32 | | | | |
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Fish collection form – Wadeable streams/ivers

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| Team members: Joshua Smith Kathryn Julian Rimu Wharakura | | GPS (d/s): E 1848393 N 5823235 | Site: Karengorengo Stream | | | | Date: 10/03/2014 | | | | | | | | |
| | | GPS (u/s): E 1848423 N 5823099 | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | | |
| Fish sample id: | Total shock time (min): 21 | Fishing time: Start 08:00 Finish 08:40 | Sample distance (m): 150 | Wetted width (m): | A 2.1 | C 2.2 | E 2.4 | G 2.8 | I 2.9 | | | | | | |
| Sampling gear: Spotlight EFM Seine | | Length (m) | Water visibility: Good | Average | Poor | Water temp. (°C): 13.9 | Conductivity (µS): 131 | | | | | | | | |
| EFM anode: Big Small | | EFM volts (x100): 3 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Shortfin eel | 13 | 14 | 4 | 2 | | | | | | | 33 | | 100 | 750 | |
| Common bully | 1 | 1 | 1 | | | | | | | | 3 | | 45 | 74 | |
| Smelt | 2 | | | | | | | | | | 2 | | 70 | 95 | |
| Brown trout | 1 | | | | | | | | | | 1 | | 130 | 130 | |
| Koura | 5 | 4 | | | | | | | | | 9 | | | | |
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| FLAG | Comment | | | | | | | | | FLAG | Comment | | | | |
| F1 | 100% macrophyte cover in reach D-J making fishing impossible | | | | | | | | | | | | | | |
| F2 | Shrimp abundant | | | | | | | | | | | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Joshua Smith Kathryn Julian Rimu Wharakura | | GPS (d/s): E 1831968 N 5803870 | Site: Wairere Stream | | | | Date: 10/03/2014 | | | | | | | | |
|---|------------------------------|--|-------------------------------------|------------------------|-------------------------------|-------------------------------|-----------------------|----------------------------|---------|----|-------------|--------------|-------------|------|------|
| | | GPS (u/s): E 1831878 N 5803808 | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | | |
| Fish sample id: | Total shock time (min): 130 | Fishing time: Start 11:20 Finish 15:22 | Sample distance (m): 150 | Wetted width (m): | A 5.2 C 6.7 E 6.0 G 4.3 I 5.7 | B 3.7 D 8.2 F 6.9 H 3.0 J 4.7 | | | | | | | | | |
| Sampling gear: | Spotlight EFM Seine | Length (m) Mesh (mm) | Water visibility: Good Average Poor | Water temp. (°C): 18.2 | Conductivity (µS): 63 | | | | | | | | | | |
| EFM anode: Big Small | EFM volts (x100): 4 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Shortfin eel | 45 | 25 | 48 | 16 | 13 | 18 | 23 | 26 | 21 | 18 | 240 | | 75 | 580 | |
| Common bully | 62 | 59 | 133 | 130 | 93 | 85 | 130 | 79 | 88 | 83 | 942 | | 20 | 76 | |
| Brown trout | | 1 | | | | | | | | | 1 | | 125 | 125 | |
| Longfin eel | | | | 1 | | | | | 1 | | 2 | | 880 | 930 | |
| Torrentfish | | | | | | | | | 2 | | 2 | | 75 | 90 | |
| Koura | 6 | 13 | 12 | 2 | 10 | | 1 | 6 | 4 | 4 | 58 | | | | |
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| FLAG | Comment | | | | | | | FLAG | Comment | | | | | | |
| F1 | Smelt seen upstream of reach | | | | | | | | | | | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Joshua Smith, Rimu Wharakura Kerry Costley Aslan Wright-Stow | | GPS (d/s): E 1852566 N 5818150 | | Site: Waiteariki Stream | | | | Date: 11/03/2014 | | | | | | | |
|---|----------------------------|--------------------------------|--------------------------------|--------------------------|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-----------------------|----------------|--------------|-------------|------|------|
| | | GPS (u/s): E 1852697 N 5818212 | | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | |
| Fish sample id: | Total shock time (min): 82 | Fishing time: | Start 08:10 Finish NA | Sample distance (m): 150 | Wetted width (m): | | A 4.5 B 6.5 | C 5.8 D 3.7 | E 4.6 F 8.0 | G 8.4 H 6.5 | I 4.3 J 6.4 | | | | |
| Sampling gear: | Spotlight | EFM | Seine | Length (m) Mesh (mm) | Water visibility: | Good | Average | Poor | Water temp. (°C): 13.6 | Conductivity (µS): 45 | | | | | |
| EFM anode: | Big Small | EFM volts (x100): 4 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Shortfin eel | 1 | 2 | | 5 | 4 | | 4 | 3 | | 1 | 20 | | 90 | 410 | |
| Banded kokopu | 2 | 2 | | | 1 | | | 1 | 1 | | 7 | | 120 | 205 | |
| Cran's bully | 4 | 2 | 9 | 8 | 10 | 6 | 3 | 2 | 1 | 3 | 48 | | 15 | 90 | |
| Longfin eel | | 1 | | | 1 | 1 | | 3 | 4 | | 10 | | 350 | 850 | |
| Brown trout | | | | 1 | 2 | 1 | | | 1 | 1 | 6 | | 117 | 250 | |
| Torrentfish | | | | | | | 1 | | | | 1 | | 100 | 100 | |
| Koura | 5 | 8 | 7 | 9 | 9 | 6 | 10 | 17 | 8 | 10 | 89 | | | | |
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Fish collection form – Wadeable streams/ivers

| Team members: Paul Franklin Kathryn Julian + student helper | | GPS (d/s): E 1845480 N 5849662 | | Site: Waitawheta River | | | | Date: 13/03/2014 | | | | | | | |
|--|----------------------------|--------------------------------|--------------------------------|--------------------------|-----------------------|-----------------------|------------------------|-----------------------|----------------------------|-----------------------|-------------|--------------|-------------|------|------|
| | | GPS (u/s): E 1845388 N 5849622 | | Not fished | Fished none collected | Fished 10 sub-reaches | Fished 5-9 sub-reaches | Fished <5 sub-reaches | FLAG for fished/not fished | | | | | | |
| Fish sample id: | Total shock time (min): 44 | Fishing time: | Start 16:45 Finish 18:05 | Sample distance (m): 150 | Wetted width (m): | A 4.6 B 4.2 | C 2.6 D 3.2 | E 2.0 F 3.3 | G 2.8 H 2.7 | I 3.7 J 4.9 | | | | | |
| Sampling gear: | Spotlight | EFM | Seine | Length (m) Mesh (mm) | Water visibility: | Good | Average | Poor | Water temp. (°C): 17.1 | Conductivity (µS): 73 | | | | | |
| EFM anode: | Big Small | EFM volts (x100): 4 | EFM pulse rate (Hz or pps): 60 | EFM pulse width (ms): 2 | Spotlight (watts): | | | | | | | | | | |
| Species | Sub-reach tally | | | | | | | | | | Total count | Sample count | Length (mm) | | FLAG |
| | A | B | C | D | E | F | G | H | I | J | | | Min. | Max. | |
| Longfin eel | 5 | | 3 | | 2 | 1 | 3 | 1 | 1 | 1 | 17 | | 250 | 750 | |
| Common bully | 7 | 8 | 11 | 14 | 9 | 4 | 3 | 4 | 1 | 3 | 64 | | 30 | 85 | |
| Shortfin eel | 1 | 1 | 1 | 12 | 2 | 1 | 3 | 2 | 1 | | 25 | | 115 | 350 | |
| Banded kokopu | 1 | | | | | | | | | | 1 | | 220 | 220 | |
| Brown trout | | 1 | | | | | | 1 | 1 | | 3 | | 145 | 150 | |
| Koura | | | | | | | 1 | 7 | 2 | | 10 | | | | |
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Appendix C Macrophytes and periphyton

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|---|----|------------------|---|----|------------|
| Stream: Mangakahika Stream | | | | Date: 14/03/2014 | | | |
| Sample Number: 1 | | | | Located number: | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | 5 | 10 | 10 | 5 | 15 | 9 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | 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 sheet

| Stream: Mangakahika Stream | | | Located number: | | Sample Number: 1 | | | Date: 14/03/2014 | | |
|----------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 1.3 | 1.8 | 0 | | | | | | 0 | |
| 2 | 1.0 | 1.2 | 0 | | | | | | 0 | |
| 3 | 1.0 | 1.3 | 0 | | | | | | 0 | |
| 4 | 2.2 | 2.2 | 0 | | | | | | 0 | |
| 5 | 2.4 | 2.4 | 0 | | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----|----|-------------------|----|----|------------|
| Stream: Waitoa Stream U/S | | | | Date: 14/03/2014 | | | |
| Sample Number: | | | | Located number: 2 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | 30 | 10 | 15 | 40 | 20 | 23 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | 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 | 17 |
| | Brown/Reddish (% cover) | | | | | | 0 |
| Submerged bryophytes | NA | | | | | | 0 |
| Iron Bacteria growths | NA | | | | | | 0 |

Macrophyte recording sheet

| Stream: Waitoa Stream U/S | | | Located number: 2 | | Sample Number: | | | Date: 14/03/2014 | | |
|---------------------------|------------------|-------------------|----------------------------------|------------------|------------------|---------|---------------|------------------|-----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | | Emergent plants | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| | | | | | Sub-total | Species | Sub-total | Species | | |
| 1 | 0.7 | 1.45 | 65 | 0 | | | | | 65 | Na |
| 2 | 1.0 | 1.3 | 35 | 0 | | | | | 35 | Na |
| 3 | 2.7 | 3.2 | 90 | 0 | | | | | 90 | Na |
| 4 | 1.7 | 2.5 | 20 | 0 | | | | | 20 | Na |
| 5 | 2.0 | 2.1 | 70 | 0 | | | | | 70 | Na |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----|----|-------------------|----|----|------------|
| Stream: Mangapapa Stream | | | | Date: 11/03/2014 | | | |
| Sample Number: | | | | Located number: 3 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | Light brown (% cover) | 30 | | 20 | 30 | 20 | 20 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Thick (>3mm) mat/film | Green/light brown (% cover) | | 20 | | | | 4 |
| | 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 | 10 | 5 | 10 | 20 | 5 | 10 |
| Iron Bacteria growths | NA | | | | | | 0 |

Macrophyte recording sheet

| Stream: Mangapapa Stream | | | Located number: 3 | | Sample Number: | | | Date: 11/03/2014 | | |
|--------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 4.3 | 6.7 | 0 | 0 | | | | | 0 | |
| 2 | 4.5 | 7.6 | 0 | 0 | | | | | 0 | |
| 3 | 5.0 | 8.1 | 5 | 5 | | | 5 | Lm, Nh | 0 | |
| 4 | 3.6 | 4.7 | 2 | 2 | | | 2 | Nh | 0 | |
| 5 | 4.6 | 4.9 | 1 | 1 | | | 1 | Lm | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----------|----------|-------------------|----------|----------|-------------------|
| Stream: Waitakaruru Stream | | | | Date: 12/03/2014 | | | |
| Sample Number: | | | | Located number: 4 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | Light brown (% cover) | | | | | | 0 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Thick (>3mm) mat/film | Green/light brown (% cover) | 10 | | 15 | 5 | | 6 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Filaments short (<2cm) | Green (% cover) | | | | | | 0 |
| | Brown/Reddish (% cover) | | | | | | 0 |
| Filaments long (>2cm) | Green (% cover) | 40 | 50 | 15 | 20 | 50 | 35 |
| | Brown/Reddish (% cover) | | | | | | 0 |
| Submerged bryophytes | NA | | | | | | 0 |
| Iron Bacteria growths | NA | | | | | | 0 |

Macrophyte recording sheet

| Stream: Waitakaruru Stream | | | Located number: 4 | | Sample Number: | | | Date: 12/03/2014 | | |
|----------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 2.1 | 4.0 | 0 | 0 | | | | | 0 | |
| 2 | 1.5 | 2.9 | 60 | 60 | | | 60 | Lm, Pk | 0 | |
| 3 | 1.7 | 3.8 | 10 | 10 | | | 10 | Lm, Pk | 0 | |
| 4 | 2.2 | 4.0 | 5 | 5 | | | 5 | Lm, Pk | 0 | |
| 5 | 2.4 | 4.4 | 0 | 0 | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----|----|-------------------|----|----|------------|
| Stream: Piakonui Stream | | | | Date: 11/03/2014 | | | |
| Sample Number: | | | | Located number: 5 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | 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 | 20 | 30 | 10 | 35 | 15 | 22 |
| Iron Bacteria growths | NA | | | | | | 0 |

| Macrophyte recording sheet | | | | | | | | | | |
|----------------------------|------------------|-------------------|----------------------------------|------------------|------------------|----------------|---------------|---------|------------------|---------|
| Stream: Piakonui Stream | | | Located number: 5 | | | Sample Number: | | | Date: 11/03/2014 | |
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | | Emergent plants | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| | | | | | Sub-total | Species | Sub-total | Species | | |
| 1 | 3.5 | 6.0 | 0 | 0 | | | | | 0 | |
| 2 | 2.8 | 6.0 | 0 | 0 | | | | | 0 | |
| 3 | 3.0 | 7.4 | 0 | 0 | | | | | 0 | |
| 4 | 2.4 | 6.0 | 0 | 0 | | | | | 0 | |
| 5 | 3.0 | 7.0 | 0 | 0 | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----|----|-------------------|----|----|------------|
| Stream: Paiakarahi Stream D/S | | | | Date: 13/03/2014 | | | |
| Sample Number: | | | | Located number: 6 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | Light brown (% cover) | 90 | 80 | 45 | 20 | 70 | 61 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Thick (>3mm) mat/film | Green/light brown (% cover) | | | | | | 0 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Filaments short (<2cm) | Green (% cover) | | | | 5 | | 1 |
| | 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 sheet

| Stream: Paiakarahi Stream D/S | | | Located number: 6 | | Sample Number: | | | Date: 13/03/2014 | | |
|-------------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 2.8 | 6.4 | 0 | 0 | | | | | 0 | |
| 2 | 3.1 | 5.8 | 0 | 0 | | | | | 0 | |
| 3 | 2.2 | 6.1 | 0 | 0 | | | | | 0 | |
| 4 | 3.6 | 5.3 | 0 | 0 | | | | | 0 | |
| 5 | 4.8 | 7.7 | 0 | 0 | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|---|---|-------------------|---|---|------------|
| Stream: Karengorengo Stream | | | | Date: 10/03/2014 | | | |
| Sample Number: | | | | Located number: 7 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | 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 sheet

| Stream: Karengorengo Stream | | | Located number: 7 | | Sample Number: | | | Date: 10/03/2014 | | |
|-----------------------------|------------------|-------------------|----------------------------------|------------------|------------------|---------|---------------|------------------|-----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | | Emergent plants | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| | | | | | Sub-total | Species | Sub-total | Species | | |
| 1 | 2.2 | 3.5 | 60 | 0 | | | | | 60 | An, Ph |
| 2 | 2.3 | 4.0 | 100 | 0 | | | | | 100 | An, Ph |
| 3 | 2.4 | 4.0 | 90 | 0 | | | | | 90 | An |
| 4 | 2.3 | 4.0 | 100 | 0 | | | | | 100 | An |
| 5 | 2.9 | 4.5 | 100 | 0 | | | | | 100 | An |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----------|----------|-------------------|----------|----------|-------------------|
| Stream: Wairere Stream | | | | Date: 10/03/2014 | | | |
| Sample Number: | | | | Located number: 8 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | 60 | 70 | | | | 26 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | 50 | | | 10 |
| | Light brown (% cover) | | | | | | 0 |
| | Black/dark brown (% cover) | | | | | 30 | 6 |
| 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 | 50 | 18 |
| | Brown/Reddish (% cover) | | | | 10 | | 2 |
| Submerged bryophytes | NA | | | | | | 0 |
| Iron Bacteria growths | NA | | | | | | 0 |

Macrophyte recording sheet

| Stream: Wairere Stream | | | Located number: 8 | | Sample Number: | | | Date: 10/03/2014 | | |
|------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 4.5 | 5.6 | 2 | 0 | | | | | 2 | Lp |
| 2 | 7.2 | 8.8 | 0 | 0 | | | | | 0 | |
| 3 | 5.8 | 5.2 | 0 | 0 | | | | | 0 | |
| 4 | 4.7 | 7.15 | 0 | 0 | | | | | 0 | |
| 5 | 5.7 | 9.0 | 0 | 0 | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----------|----------|-------------------|----------|----------|-------------------|
| Stream: Waiteariki Stream | | | | Date: 11/03/2014 | | | |
| Sample Number: | | | | Located number: 9 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | | | | | 0 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | 5 | 5 | 3 | | 2.6 |
| | Light brown (% cover) | | | | | | 0 |
| | Black/dark brown (% cover) | | | | | | 0 |
| Thick (>3mm) mat/film | Green/light brown (% cover) | | | | | 10 | 2 |
| | 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 | 10 | 2 | 2 | 2 | 10 | 5.2 |
| Iron Bacteria growths | NA | | | | | | 0 |

| Macrophyte recording sheet | | | | | | | | | | |
|----------------------------|------------------|-------------------|-------------------|----------------------------------|------------------|----------------|-----------------|---------|------------------|---------|
| Stream: Waiteariki Stream | | | Located number: 9 | | | Sample Number: | | | Date: 11/03/2014 | |
| Transect | Wetted width (m) | Channel width (m) | Total cover | Vegetation cover (% wetted area) | | | | | | |
| | | | | Total submerged | Submerged plants | | Emergent plants | | | |
| | | | | | Sub-total | Species | Sub-total | Species | Total emergent | Species |
| | | Surface-reaching | | Below surface | | | | | | |
| 1 | 4.5 | 25.0 | 0 | 0 | | | | | 0 | |
| 2 | 6.5 | 15.0 | 0 | 0 | | | | | 0 | |
| 3 | 5.8 | 15.0 | 0 | 0 | | | | | 0 | |
| 4 | 3.7 | 18.0 | 0 | 0 | | | | | 0 | |
| 5 | 4.6 | 20.0 | 0 | 0 | | | | | 0 | |

| Periphyton Assessment | | | | | | | |
|---------------------------------|-----------------------------|----|---|--------------------|---|-----|------------|
| Stream: Waitawheta River | | | | Date: 13/03/2014 | | | |
| Sample Number: | | | | Located number: 10 | | | |
| Thickness category | Colour category | A | B | C | D | E | Mean cover |
| Thin (<0.5mm) Mat/Film | NA | | 5 | | 1 | | 1.2 |
| Medium mat/film (0.5-3mm thick) | Green (% cover) | | | | | | 0 |
| | 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 | | 30 | | 0.5 | 10.1 |
| | Brown/Reddish (% cover) | | | | | | 0 |
| Submerged bryophytes | NA | | | | | | 0 |
| Iron Bacteria growths | NA | | | | | | 0 |

Macrophyte recording sheet

| Stream: Waitawheta River | | | Located number: 10 | | Sample Number: | | | Date: 13/03/2014 | | |
|--------------------------|------------------|-------------------|----------------------------------|------------------|------------------|--|---------------|------------------|----------------|---------|
| Transect | Wetted width (m) | Channel width (m) | Vegetation cover (% wetted area) | | | | | | | |
| | | | Total cover | Submerged plants | | | | Emergent plants | | |
| | | | | Total submerged | Surface-reaching | | Below surface | | Total emergent | Species |
| Sub-total | Species | Sub-total | Species | | | | | | | |
| 1 | 4.6 | 5.3 | 0 | 0 | | | | | 0 | |
| 2 | 4.2 | 4.3 | 0 | 0 | | | | | 0 | |
| 3 | 2.6 | 7.2 | 0 | 0 | | | | | 0 | |
| 4 | 3.3 | 3.3 | 0 | 0 | | | | | 0 | |
| 5 | 2.7 | 5.2 | 0 | 0 | | | | | 0 | |

Appendix D Macroinvertebrate taxa list

| Species | Sites | | | | | | | | | |
|---------------------------------|-------|----|---|----|----|----|----|----|-----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| <i>Archichauliodes diversus</i> | 68 | 1 | | 4 | 18 | 28 | | | 24 | 4 |
| <i>Antipodochlora braueri</i> | | | | | | | | 1 | | 1 |
| <i>Xanthocnemis zealandica</i> | | | 1 | | | | 16 | 12 | | |
| <i>Ameletopsis perscitus</i> | | | | | 2 | | | | 4 | |
| <i>Austroclima</i> sp. | | 12 | | | 44 | 4 | 48 | | 24 | |
| <i>Austroclima sepia</i> | | 1 | 1 | | 18 | 8 | | | 24 | 4 |
| <i>Deleatidium</i> spp. | 8 | 60 | | | | | | | | 12 |
| <i>Coloburiscus humeralis</i> | | | 1 | | 38 | 8 | | | 128 | 12 |
| <i>Maiulus luma</i> | | | | | | | | | 8 | 12 |
| <i>Neozephlebia scita</i> | 2 | | | | 14 | | 16 | | | |
| <i>Nesameletus</i> sp. | | | | | 1 | | | | 52 | 20 |
| <i>Rallidens Mcfarlanei</i> | | | | | | | | | | 4 |
| <i>Zephlebia</i> spp. | 2 | 4 | | | 80 | | 96 | | | |
| <i>Zephlebia borealis</i> | 2 | 1 | | | | | | | | 4 |
| <i>Zephlebia dentata</i> | 2 | | | 20 | 26 | | 24 | | 4 | |
| <i>Zephlebia inconspicua</i> | | | | 1 | | | | | | |
| <i>Zephlebia spetabilis</i> | 1 | | | | | | | | | |
| <i>Zephlebia versicolor</i> | | | | | 10 | | 16 | 36 | 1 | 4 |
| <i>Acroperla</i> sp. | | | | | | 4 | | | | |
| <i>Austroperla cryene</i> | | | | | 2 | | | | | 1 |
| <i>Megaloptoperla grandis</i> | | | | | 2 | | | | | |
| <i>Zelandoperla decorata</i> | | | | | | | | | 8 | 4 |
| <i>Aoteapsyche catherinae</i> | | | 1 | | | | | | 4 | |
| <i>Aoteapsyche colonica</i> | 6 | 4 | | 28 | | 20 | | | 16 | |
| <i>Aoteapsyche tepoka</i> | | | 1 | | | | | | | |
| <i>Aoteapsyche</i> spp. | | 4 | 2 | 8 | | 44 | | | 48 | 12 |
| <i>Beraeoptera roria</i> | | | | | | 60 | | | | |
| <i>Confluens olingoides</i> | | | | | | | | | 8 | |
| <i>Costachorema</i> spp. | | | | | | | | | 1 | |
| <i>Helicopsyche</i> spp. | | | | | 2 | | | | | 1 |
| <i>Hudsonema alienum</i> | 8 | | | | | | | 4 | | |
| <i>Hudsonema amabilis</i> | | 4 | | 36 | | | | 36 | 8 | 4 |
| <i>Hydrobiosella mixa</i> | | | | | 1 | | | | | |
| <i>Hydrobiosis</i> spp. | 2 | 1 | | 8 | 1 | 1 | | 1 | 4 | 8 |
| <i>Hydrobiosis (pupa)</i> | | | | | | | | | | 4 |
| <i>Hydrobiosis copis</i> | | 1 | | | | | | | 1 | |

| Species | Sites | | | | | | | | | |
|-----------------------------------|-------|-----|---|-----|----|----|-----|-----|----|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| <i>Hydrobiosis parumbripennis</i> | | | | | | | 8 | | | |
| <i>Neurochorema</i> spp. | 6 | | | | | | 16 | | | |
| <i>Neurochorema confusum</i> | | | | | | 16 | | 4 | | 1 |
| <i>Neurochorema armstrongi</i> | | | | | | | | | 4 | |
| <i>Ocetis unicolor</i> | | | | | | | 1 | | | |
| <i>Olinga feredayi</i> | 10 | 8 | | | | | | | | |
| <i>Orthopsyche</i> spp. | | | | | 24 | | | | 4 | |
| <i>Orthopsyche fimbriata</i> | | | | | 4 | | | | 4 | |
| <i>Oxyethira albiceps</i> | | 1 | | | | 72 | 8 | 100 | 24 | 28 |
| <i>Oxythira</i> pupa | | | | | | 4 | | | | |
| <i>Paroxythira</i> sp. | | | 1 | | | | | 20 | 4 | 4 |
| <i>Polyplectropus</i> sp. | 6 | | | | | | 1 | 1 | 4 | 4 |
| <i>Psilochorema mimicum</i> | | | | | | | | | | 1 |
| <i>Pycnocentria evecta</i> | 26 | 12 | 8 | | 2 | | | 20 | | 12 |
| <i>Pycnocentrodes</i> sp. | 112 | 592 | | 248 | | 80 | | 4 | 72 | 4 |
| <i>Triplectides obsoletus</i> | 6 | | 1 | | 1 | | 104 | 48 | 12 | 20 |
| <i>Zelolessia cheira</i> | | | | | 2 | | | | 24 | |
| <i>Aphrophila neozelandica</i> | | | | | | 4 | | | 4 | |
| <i>Austrosimulium</i> sp. | | 1 | 2 | 12 | 2 | 32 | 48 | 12 | 52 | 1 |
| <i>Corynoneura</i> sp. | | | | | | | 8 | 4 | | |
| <i>Cricotopus</i> spp. | | | | | | 44 | | 48 | 44 | 8 |
| <i>Hexatomini</i> sp. | | | | | | | 1 | | | |
| <i>Kaniwhaniwhanus</i> | 6 | | | | 2 | | | | 4 | |
| Lobodiamesinae | | | | | | | | | | 1 |
| Tanypodinae =Macropelopiini sp. | | | | | | | 1 | 52 | 4 | 8 |
| <i>Maoridiamesa</i> sp. | | | | | | 4 | | | | |
| Muscidae | | | 1 | | | | | | | |
| <i>Naonella forsythi</i> | | | | 4 | | 24 | | 36 | | 12 |
| <i>Nothodixa</i> sp. | | | | | 2 | | | | | |
| Orthocladinidae sp. | 24 | | | | 6 | | | 4 | | |
| <i>Paradixa</i> sp. | 4 | | | | | | 96 | 20 | | |
| <i>Polypedilum</i> spp. | 6 | | | | 4 | | 1 | | | |
| Tabanidae | 10 | | | | 1 | 1 | | | | |
| <i>Tanytarsus</i> spp. | 8 | | | | | 56 | | 44 | 25 | 44 |
| Tanyderidae | | | | | | | 1 | | | |
| Elmidae (larvae) | 6 | 4 | | 352 | 10 | 84 | 8 | 48 | 12 | 28 |
| Hydraenidae (A) | | | | | 1 | 4 | | | | |
| Hydrophilidae (A) | | | | | 1 | | | | | |

| Species | Sites | | | | | | | | | |
|----------------------------------|-------|-----|-----|-----|---|-----|-----|-----|----|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Ptilodactylidae (larvae) | | | | | 2 | | | | | |
| Scirtidae | | | | | 2 | | | | | |
| <i>Latia neritoides</i> | | | | 1 | | 1 | | | 8 | 60 |
| <i>Lymnaea</i> sp. | | 1 | | | 2 | | | | | |
| <i>Physa</i> sp. | | | | 1 | | | 8 | | | |
| <i>Potamopyrgus antipodarum</i> | 12 | 296 | 788 | 184 | 8 | 176 | 928 | 360 | 28 | 484 |
| Oligochatea | | | | | | | | | 4 | |
| Naididae | 2 | | | | | 4 | | 12 | 4 | |
| Plathylminthes | 2 | | | 1 | | | | | 1 | |
| Leach | 2 | | | 1 | | | | | | |
| Ostracoda | 26 | | | | | | 24 | | | |
| <i>Paracalliope fluviatus</i> | | | | 8 | | | 40 | 8 | | |
| <i>Paranephropus planiforins</i> | | | | | 1 | | | | | |