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Piako catchment ecological monitoring 2012

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Waihekau Stream electric fishing. [Paul Franklin, NIWA]

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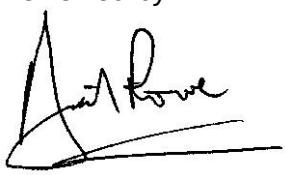

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Executive summary

Water allocation in the Piako catchment exceeds the current limits defined in the Waikato Regional Plan and there are concerns regarding the potential impacts of reduced flows on water quality and the ecological status of streams in the catchment. The aim of this study was to establish a network of baseline ecological monitoring sites to contribute towards supporting the water allocation decision making process in the Piako catchment.

Ten sites in the upper Piako catchment were surveyed for fish, macroinvertebrates, macrophytes and periphyton in February 2012. Flows were above average for that time of year due to the wet summer in 2011-12. A total of eight different fish species, seven native and one exotic, were captured across the ten survey sites. Of those eight species, only shortfin eel (*Anguilla australis*) was present at all ten sites. Fish communities in the Piakoiti/Piakonui sub-catchment were limited by the presence of a natural migration barrier in the Piako River upstream of Morrinsville. This meant that migratory species without the capability to climb, e.g., inanga and torrentfish, were absent from this sub-catchment. The presence of these species in other sub-catchments indicates good downstream connectivity elsewhere in the catchment.

Macroinvertebrate communities were generally poorer in lowland, low gradient sites as evidenced by lower occurrence of desired EPT taxa and lower MCI scores. This reflects differences in habitat structure and water quality. Aquatic macrophytes were also more abundant in these streams. This is a consequence of a greater frequency of soft substrates where they can root, lower water velocities and high light availability. It probably also reflects higher nutrient availability.

The Piako catchment is widely acknowledged as being significantly impacted by land use change and the effects of agricultural development and intensification. The results of this study therefore reflect the consequences of human induced changes on aquatic ecosystem structure and functioning. Establishment of routine monitoring sites is essential for understanding natural variability in ecological communities and for detecting the consequences of human induced changes in the river environment. These results provide a valuable foundation for reassessing environmental flow requirements in the Piako catchment. Key areas of concern for this reassessment are likely to include assimilative capacity, connectivity at migration barriers under low flows, water temperatures, dissolved oxygen dynamics and physical habitat suitability.

1 Introduction

1.1 Background

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

One of the key objectives of the water allocation process is to safeguard the life supporting capacity of freshwater ecosystems (MfE 2011). Water allocation in the Piako catchment exceeds the current limits defined in the Plan and there are concerns regarding the potential impacts on water quality and ecological status in the catchment. As a precursor to the review of flow and allocation limits in the Piako catchment scheduled for 1 July 2014 (Table 3-4A; Waikato Regional Council 2012), WRC have initiated investigations in the catchment to support and inform the review process. The aim of this study was to establish a network of baseline ecological monitoring sites to contribute towards supporting the water allocation decision making process in the catchment.

1.2 Study brief

The scope of this study was to establish ten baseline ecological monitoring sites and undertake monitoring of fish, macroinvertebrates, periphyton and macrophytes in the Piako River catchment, as a pre-cursor to undertaking an evaluation of the status of water resources in the catchment. The ten sites were to be located in the upper Piako catchment (approximately defined as upstream of Morrinsville) and were to encompass representative habitats from the main tributaries of the Piako, excluding the Topehaehae Stream, which is subject to the influence of the Morrinsville water supply reservoir.

2 Methodology

2.1 Sites

Ten monitoring sites were selected throughout the main sub-catchments of the upper Piako catchment on the basis of representativeness of differing habitat types (Table 2-1; Figure 2.1). The Topehaehae catchment was excluded from consideration at the request of WRC due to the known influence of the Morrinsville water supply dam. All sites were sampled between 13 and 17 February 2012.

Land use throughout the catchment is dominated by dairy farming and this has a strong influence on water quality and riparian structure in the majority of streams and rivers. Streams in the eastern sub-catchments (Waihekau and Waitoa) are typically low gradient, slow flowing and macrophyte dominated (Sites 7 and 8). Many of these channels have also been modified by straightening and dredging. The Mangapapa and Piakonui sub-catchments are characterised by steeper gradient streams with more varied morphology and rocky substrates (Sites 4-6). The headwaters of the Piakonui (Site 4) flow through native bush in the Te Tapui Scenic Reserve and represent the most intact and natural stream habitats in the catchment. The Waitakaruru sub-catchment drains the western part of the Piako catchment, joining the Piako River at Morrinsville. The main stem of the Waitakaruru Stream (Site 2) is a medium to low gradient stream, which becomes increasingly heavily modified and macrophyte dominated between Tauwhare and Morrinsville. It has frequent tributaries joining from the true right, draining the Pakaroa Ranges. These higher gradient streams (Sites 1 and 10) typically have more varied morphology and rockier substrates relative to the main stem, but are still strongly influenced by agricultural land use practices.

Table 2-1: Ecological monitoring site locations.

Site	Stream	Easting*	Northing*	Comments
1	Waitakaruru Stream tributary	2728090	6380572	Upland agricultural stream
2	Waitakaruru Stream	2727985	6377350	Mid gradient agricultural stream
3	Piakoiti Stream	2746139	6379564	Low gradient agricultural stream
4	Piakonui Stream	2741486	6371826	Upland native bush stream
5	Piakonui Stream	2742763	6376343	Upland bedrock stream
6	Mangapapa Stream	2747006	6371508	Upland rough pasture stream
7	Waitoa River	2750045	6366003	Low gradient agricultural stream
8	Waitoa River	2742190	6365404	Upland rough pasture stream
9	Waihekau Stream	2753911	6381502	Low gradient agricultural stream
10	Waitakaruru Stream tributary	2730406	6389244	Mid gradient bush stream

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

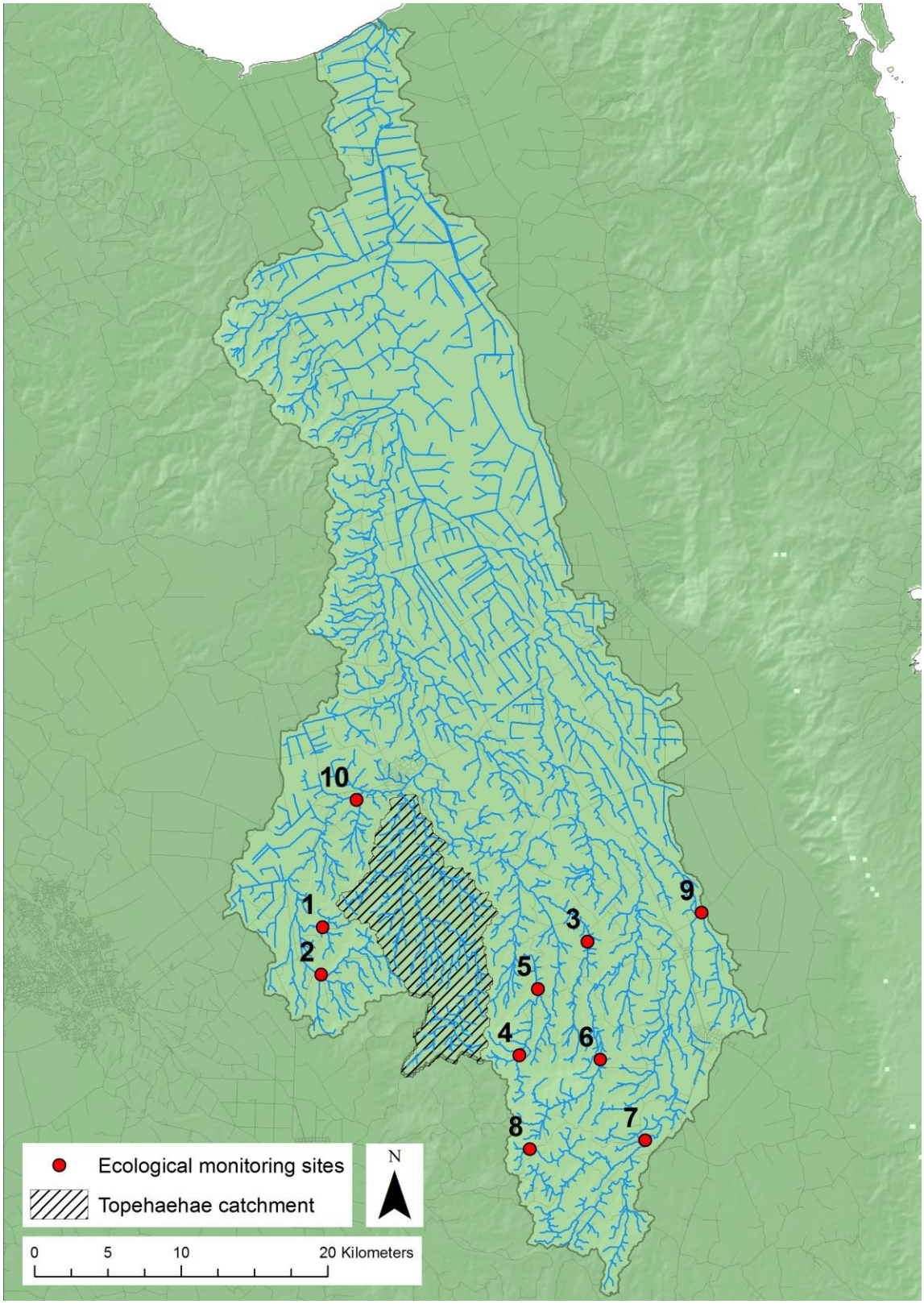

Figure 2.1: Map the Piako catchment showing the location of the ten ecological monitoring sites.

2.2 Fish

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

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

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

2.3 Macroinvertebrates

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

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

2.4 Macrophytes & periphyton

Macrophyte and periphyton surveys were carried out following the standardised procedures for wadeable streams as outlined by WRC (Collier et al. 2006). At each of five transects located in the reach, periphyton cover was assessed at five points (10%, 30%, 50%, 70% and 90%) across the wetted width of the stream and the area of macrophyte cover occupying the 1 m wide band upstream of the transect was estimated. Details of the thickness and cover of periphyton were recorded allowing calculation of the Periphyton Enrichment Index (PEI) and a range of periphyton biomass indices (Collier et al. 2006). The percentage cover of different submerged and emergent species of macrophytes was also recorded, allowing calculation of the macrophyte cover indices (Collier et al. 2006).

3 Results

3.1 Site descriptions

3.1.1 Site 1 – Waitakaruru Stream tributary 1

This site is located on a tributary of the Waitakaruru Stream just downstream of Tauwhare, off Tahuroa Road. It is a third order stream and the site lies approximately 90 km from the sea at an elevation of 70 m above mean sea level. Instream habitat was about 60% run, 25% riffle and 15% pools. Mean stream width was 2.5 m and mean depth around 0.3 m. Substrate was a combination of cobbles, gravel and silt. Adjacent land use is pastoral. Some riparian vegetation is intact providing shade to the stream, but a lack of fencing means that stock have access to the stream. Further details on the physical characteristics of this and all the other sites can be found in Appendix A.

3.1.2 Site 2 – Waitakaruru Stream

The second site is located on the Waitakaruru Stream, just upstream from the Waitakaruru Arboretum and adjacent to Scotsmans Valley Road. Land use on the true right bank is a mix of forestry and pasture and primarily pasture on the true left bank. It is a fourth order stream and the site is at an elevation of approximately 70 m and about 93 km from the sea. Mean stream width was 2.5 m and mean depth 0.3 m. Instream habitat was primarily a combination of runs (60%) and riffles (35%), with a gravel substrate. Riparian fencing was absent, but stock only had access to the stream in the upper third of the survey reach. Riparian planting has been carried out in the lower two thirds of the reach providing some cover and shading.

3.1.3 Site 3 – Piakoiti Stream

The Piakoiti Stream survey site was located adjacent to Piakoiti Road approximately 800 m upstream from the Morrinsville-Walton Road. Land use throughout this catchment is strongly dominated by dairying, with riparian vegetation largely absent. High light levels combined with elevated nutrient and sediment inputs contribute to a high abundance of aquatic macrophytes in the stream. Stream order at the survey site is three, at an elevation of approximately 60 m and distance from the sea of 92 km. Instream habitat is primarily run (98%), with occasional small pools present reflecting the effects of channel dredging. Substrate in the channel is dominated by silt and mean width and depth about 2.5 m and 0.5 m respectively.

3.1.4 Site 4 – Piakonui Stream (upstream)

This site is located at the edge of the Te Tapui Scenic Reserve and therefore had intact native riparian cover. Instream habitat was highly varied and constituted approximately equal parts of runs, riffles and pools, with occasional rapids. Consistent with the intact riparian zone, there was also a good supply of woody debris in the stream, providing additional habitat, and the stream was well shaded resulting in notably lower water temperatures than the other sites (15.5 °C). The site is a second order stream and the distance inland is 100 km, with an elevation of 142 m. Mean channel width was 2.4 m and mean depth about 0.4 m. The substrate was 50% cobble, 30% boulders and 20% silt.

3.1.5 Site 5 – Piakonui Stream (downstream)

This site is located 6 km downstream from Site 4 at an elevation of 60 m. Land use adjacent to this site is dairying. Riparian vegetation is absent and there is no fencing in place to prevent stock access to the stream. Average stream width is 3.5 m and depth about 0.3 m. The substrate is primarily bedrock throughout the reach, which has a strong influence on instream habitat which was about 60% run and 40% riffles. The only cover available is provided by overhanging grasses at the stream edge. Water temperature increased from 15.5 °C at Site 4 to 20.7 °C at this site, primarily due to a lack of shading.

3.1.6 Site 6 – Mangapapa Stream

The Mangapapa Stream is a tributary of the Waitoa River. The survey site is located approximately 107 km from the sea at an elevation of 93 m. Substrate at the monitoring site is primarily bed rock. Instream habitat is a combination of riffles (50%), runs (40%) and pools (10%). The adjacent land use is rough pasture and no riparian fencing is present. Riparian vegetation is primarily limited to grasses, but there are small areas where planting has been carried out and a more complex community including flax and small shrubs occur. The mean channel width at the site is 4.1 m and mean depth about 0.25 m.

3.1.7 Site 7 – Waitoa River

The Waitoa River is the main tributary of the Piako, draining the eastern part of the catchment. Land use at this site was dairying, but riparian fencing was in place on both banks preventing access to the stream by stock. At the survey site, the Waitoa River is a fifth order stream with a mean width of 3.9 m and average depth of 0.6 m. Distance inland is approximately 115 km and elevation of the site 80 m above sea level. Instream habitat at the site is dominated by runs (75%), with occasional pools present. The substrate is a combination of sand (60%), gravels (20%) and silt (20%). Marginal emergent macrophytes provided some cover at the stream edges, but overall the river was quite open.

3.1.8 Site 8 – Waitoa River (headwaters)

This site was located in the headwaters of the Waitoa River where they pass under Buckland Road. The survey site is located 125 km from the sea and at an elevation of 145 m above sea level. The gradient in this reach is relatively steep and habitat is a relatively diverse combination of riffles (55%), runs (25%), pools (15%) and the occasional rapid. There is a small chute in the upper part of the reach, which is likely to act as a barrier to migration for some fish species. Substrate was mainly a combination of cobbles (65%) and boulders (15%). Land use was rough pasture, primarily used for sheep grazing. There was no riparian fencing on either bank and riparian vegetation was limited. Instream cover was provided by boulders. Average stream width at the site was 1.5 m and mean depth about 0.2 m.

3.1.9 Site 9 – Waihekau Stream

The Waihekau Stream is another tributary of the Waitoa River and drains the eastern part of the Piako catchment. There is evidence to suggest that this stream has been subject to channel modifications including dredging, straightening and widening, leading to an incised and very uniform channel (99% run). The survey site is located 85 km from the sea at an elevation of 84 m. Stream width averages 3.3 m and mean depth is 0.7 m. Substrate in the stream is primarily sand (90%), with some areas of silt also present. Land use on the adjacent banks is dominated by dairying. Both riparian areas are fenced off from stock, but

riparian vegetation cover is limited to grasses and occasional scrub. Dissolved oxygen was below recommended levels in the reach at 5.5 mg l^{-1}.

3.1.10 Site 10 – Waitakaruru Stream tributary 2

The final site is another tributary of the Waitakaruru Stream, but is located further downstream than Sites 1 or 2, close to Morrinsville. The monitoring site is in an area of mixed bush, providing shading and a good supply of woody debris to the stream. The site is located 75 km inland and its elevation is 37 m. Stream width was 2.6 m and instream habitat relatively varied (57% pool, 31% run, 12% riffle). Substrate was a mix of sand (55%), silt (30%) and gravel (10%). Water temperature was relatively low (17.8°C) compared to the other survey sites, reflecting the high degree of shading.

3.2 Fish

A total of eight different fish species, seven native and one exotic, were captured across the ten survey sites (Table 3-1; Appendix B). Of those eight species, only shortfin eel (*Anguilla australis*) was present at all ten sites. The only exotic species to be captured was gambusia (*Gambusia affinis*), which was recorded at four of the sites. Two species, banded kokopu (*Galaxias fasciatus*) and smelt (*Retropinna retropinna*), were only recorded at a single site (Site 4 and Site 7 respectively).

Shortfin eels were the most abundant species at the majority of sites, with the largest numbers being caught at Site 8 (254) and Site 3 (225). The only site where their abundance was very low was Site 4, where only five were captured. Figure 3.2shows the presence of shortfin eels recorded in this survey, relative to their predicted probability of capture within the catchment (Leathwick et al. 2008). It can be seen that shortfin eels have a high probability of capture throughout the majority of the catchment. In general, the abundance of shortfin eels captured during this survey largely matches the predicted likelihood of capture (Figure 3.2). The most obvious exceptions are Site 8, which had a much higher abundance than expected and Site 9, which had a lower abundance than expected. The reason for the particularly high abundance at Site 8 is unclear, but at Site 9, we suspect that the lower than expected abundance is probably a consequence of eel harvesting in the stream, with the abundance of eels noticeably increasing with distance upstream from the road crossing at the downstream boundary of the survey reach. Relative to the historical records of shortfin eel distribution in the catchment based on records from the New Zealand Freshwater Fish Database (NZFFD), this survey has shown that shortfin eels are present further inland and in a greater number of sub-catchments than previously recorded (Figure 3.3). The size structure of captured shortfin eels shows a dominance of eels <400 mm in length. The 100-200 mm size class accounted for over 30% of the population, with the median length across all sites being 213 mm, and between sites ranging from 107 mm at Sites 3 and 6, to 350 mm at Site 3. It is likely that the higher median length at Site 3 is partially a consequence of the silty substrate and high abundance of macrophytes, which reduces the efficiency of capture for the small size classes.

Longfin eels (*Anguilla dieffenbachii*) were captured in relatively low abundance at seven of the ten survey sites (Table 3-1; Figure 3.4). The highest abundance of longfin eels (26) was at Site 5. It is notable that the seven sites where they were present were those located furthest upstream, which coincides with the areas with the highest predicted probability of capture in the catchment (Figure 3.4). Again, relative to the historical records in the NZFFD,

this survey has shown the distribution of longfin eels to be more widespread than previously recorded in the upper parts of the catchment (Figure 3.4; Figure 3.5). The overall low abundance of longfin eels means that it is difficult to make any definitive comments regarding the size structure of the population. The median length across all sites was considerably larger than for shortfin eels at 550 mm, and the largest proportion (40%) were in the 400-600 mm size range.

Bullies (*Gobiomorphus* sp.) were captured at all sites except Site 9 (Table 3-1; Figure 3.6). Due to increasing uncertainty over the reliability of consistent morphological differentiation between populations of common bully (*Gobiomorphus cotidianus*) and Cran's bully (*Gobiomorphus basalis*) in the region (Bruno David, personal communication), we have also taken consideration of the presence of small size classes (<30 mm) relative to distance from the sea, and the presence of migration barriers, in determining the species present at each site. In the absence of lentic environments suitable for the establishment of non-diadromous (i.e., don't migrate from the sea to freshwater) common bully populations, it has been assumed that the occurrence of small size classes of bully at sites >80 km inland indicates the presence of Cran's bullies, which are known to have a non-diadromous life history. At seven of the nine sites where bully were present in the current survey, there were fish in the <30 mm size classes and it was concluded that these populations were most likely Cran's bully. At Site 4, only a single bully (45 mm) was captured, but based on the presence of Cran's bully at Site 5, which is downstream, and probable barriers to migration between the two sites, it was concluded that this was also most likely a Cran's bully. At Site 3, bullies were only captured down to 30 mm, but sampling efficiency for small fish was relatively poor in this reach due to the abundance of sediment and macrophytes and adjacent sub-catchments were all home to Cran's bullies, leading us to conclude that this population is also most likely Cran's bullies. Because genetic work has indicated that in most cases, the common bully and Cran's bully rarely co-occur (Bruno David, personal communication), it has been assumed that all the bully populations identified consisted of a single species. However, it is possible that in some cases there may also be common bully present.

It can be seen that the predicted probability of capture for Cran's bully is relatively low throughout the majority of the catchment (Figure 3.6). Despite this, the sites where Cran's bullies were identified as present largely coincide with reaches having a higher probability of capture. The distribution also generally matches the historical pattern indicated by the NZFFD records (Figure 3.7). Sizes of Cran's bullies ranged from 15 – 84 mm total length, with a median length of 40 mm. It is suggested that this range probably represents three separate year classes, indicating that recruitment and survival of this species is relatively good.

The remaining species that were captured were present in only a limited number of sites and in low abundance. The most common was inanga (*Galaxias maculatus*), which was recorded at five sites (Figure 3.8), but only at one (Site 9) in any abundance (16). Inanga is a short-lived species, typically thought to complete its entire life-cycle within a year. It is also a relatively poor climber and is therefore more susceptible to the effects of migration barriers such as floodgates, weirs and waterfalls. The presence of inanga at these sites therefore indicates good downstream connectivity. It is notable that relative to both the predicted probability of capture and the historical pattern of occurrence indicated by the NZFFD records, the current results are unusual in that they indicate much greater inland penetration

of inanga than may have been expected (Figure 3.8; Figure 3.9). The maximum size recorded (141 mm) suggests that some of these fish are maturing at two or even three years of age, rather than the usual one, giving them greater opportunity to continue their inland migration (Figure 3-1).

Figure 3-1: Large inanga caught at Site 8.

The next most commonly occurring species was torrentfish (*Cheimarrichthys fosteri*), which was recorded at four sites (Table 3-1; Figure 3.10). This is also a diadromous species and its presence at these four sites further confirms the existence of good downstream connectivity. Torrentfish display a strong preference for fast flowing water in riffles over gravel and cobble. This habitat preference can make them susceptible to the effects of low flows, but also explains the relatively low abundance and low predicted probability of capture (Figure 3.10). There were previously very few records of torrentfish in the Piako catchment (Figure 3.11), particularly this far inland, making this an important finding. The torrentfish captured ranged in size from 25 mm (Site 7) to 136 mm (Site 8), with the average length being approximately 85 mm.

Two further native species were recorded during this survey, smelt (Figure 3.12) and banded kokopu (Figure 3.14). Both species are diadromous, but banded kokopu are capable of much greater inland penetration due to their superior climbing capabilities. Smelt were only recorded in the main stem of the Waitoa River (Site 7), but suitable habitat probably also occurs in the Waihekau Stream at Site 9. This is the furthest upstream that smelt have been recorded in the Piako catchment (Figure 3.13). A single banded kokopu was captured at Site 4, which is also the only location in the upper catchment where this species has previously been recorded (Figure 3.14; Figure 3.15). The predicted probability of capture data indicate that the majority of the catchment is relatively unsuitable for banded kokopu (Figure 3.15). This is most likely because they display a preference for first and second order streams, with intact riparian vegetation and instream cover, which are uncommon in the Piako catchment

due to agricultural development. It is also worth noting that no trout were captured during the surveys and that no trout are recorded in the NZFFD for the catchment.

Overall, species richness at the survey sites was low, with an average of four species. The maximum richness was recorded at Site 7 on the main stem of the Waitoa River, where seven species were recorded. The lowest species richness was recorded at Site 3 on the Piakoiti Stream, where only two species were recorded. Due to the high proportion of diadromous fish species in New Zealand, fish species richness typically falls with distance from the sea and increasing elevation. However, analysis of the data from this survey indicated a positive correlation between fish species richness and distance inland ($r^2 = 0.39$; $p = 0.05$) and no relationship with elevation ($r^2 = 0.08$; $p = 0.42$).

Analysis of the catch data indicated that, at the majority of sites, all species were encountered in the first 50 m of the survey reach, and that in all cases the full diversity of species was recorded within 130 m. The relatively short distance required for the majority of sites to capture the full diversity of species is probably a reflection of the relatively low diversity of habitats present in many of the sites.

Table 3-1: Results of 2012 electric fishing survey at the ten Piako catchment monitoring sites. Ab. = Number caught; Rel. Ab. = Relative abundance (Individuals per 100 m^2); * Classified as Cran's bully due to size structure of population and distance inland.

Site	Shortfin eel		Longfin eel		Cran's bully		Torrentfish		Inanga		Smelt		Banded kokopu		Gambusia		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.
1. Waitakaruru tributary 1	89	24.1	3	0.81	114	30.8	-	-	-	-	-	-	-	-	-	-	2	0.54
2. Waitakaruru Stream	154	41.5	8	2.15	97	26.1	3	0.81	-	-	-	-	-	-	5	1.35	26	7.00
3. Piakoiti Stream	225	70.6	-	-	16	5.02	-	-	-	-	-	-	-	-	-	-	15	4.71
4. Piakonui Stream u/s	5	1.39	6	1.67	1	0.28	-	-	-	-	-	-	1	0.28	-	-	106	29.4
5. Piakonui Stream d/s	116	21.9	26	4.90	26	4.90	-	-	-	-	-	-	-	-	-	-	34	6.40
6. Mangapapa Stream	116	18.8	6	0.97	91	14.7	2	0.32	4	0.65	-	-	-	-	-	-	21	3.40
7. Waitoa River	209	36.1	2	0.35	62*	10.7	4	0.69	1	0.17	2	0.35	-	-	10	1.73	33	5.70
8. Waitoa headwaters	254	115	6	2.72	62*	28.1	3	1.36	1	0.45	-	-	-	-	-	-	44	20.0
9. Waihekau Stream	79	16.2	-	-	-	-	-	-	16	3.27	-	-	-	-	2	0.41	16	3.27
10. Waitakaruru tributary 2	69	17.6	-	-	178	45.5	-	-	1	0.26	-	-	-	-	5	1.28	54	13.8

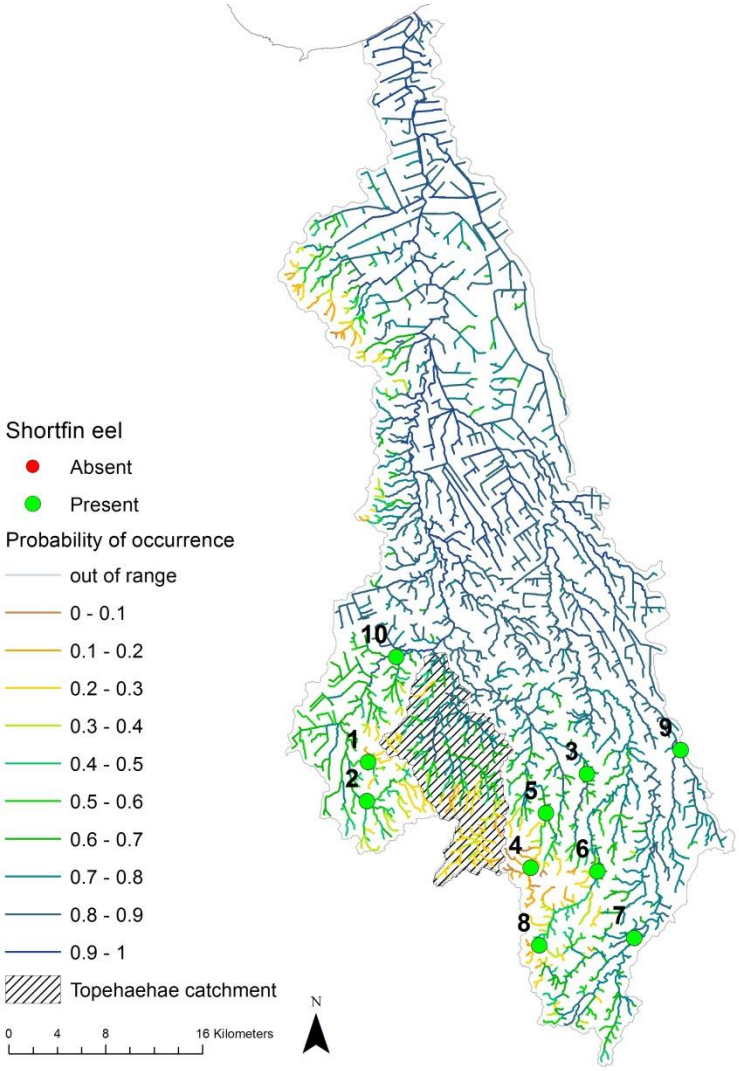

Figure 3.2: Presence and absence of shortfin eels during this survey relative to predicted probability of capture.

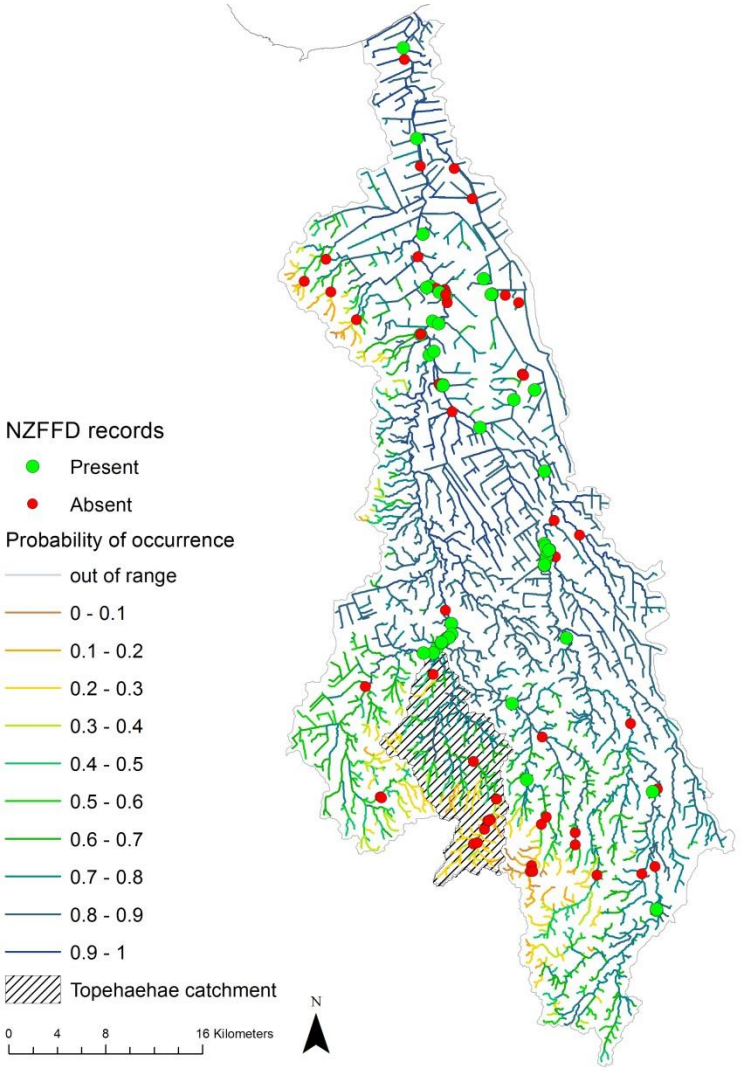

Figure 3.3: Presence and absence of shortfin eels in the Piako catchment based on NZFFD records (Dec 2011).

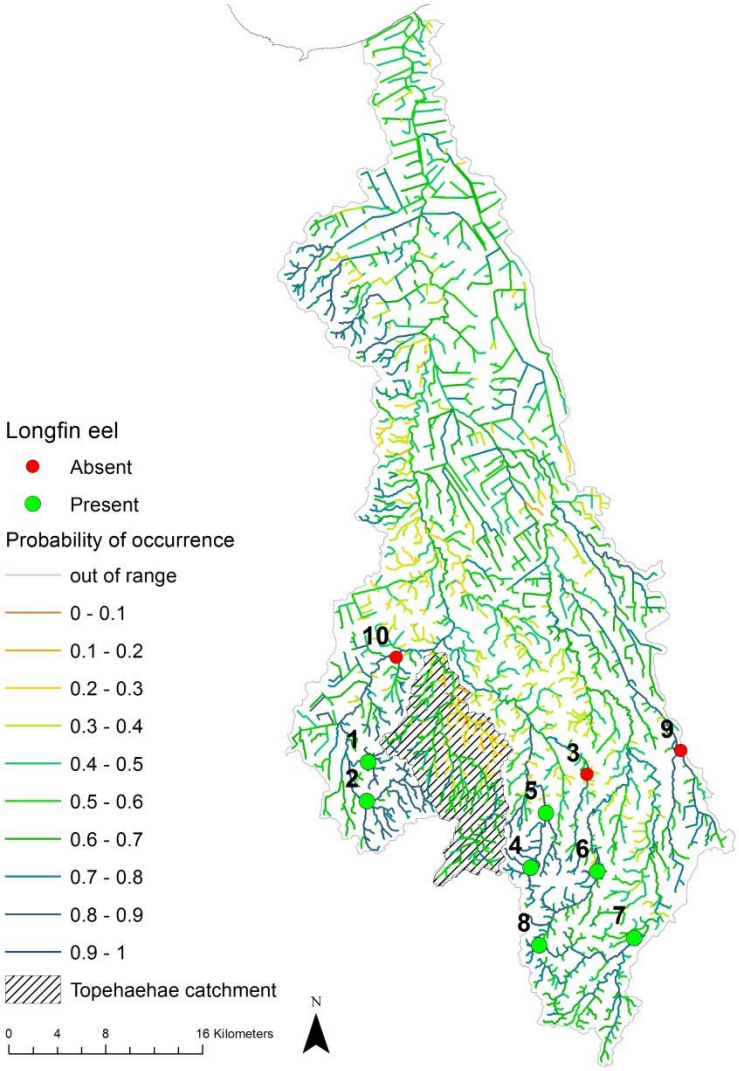

Figure 3.4: Presence and absence of longfin eels during this survey relative to predicted probability of capture.

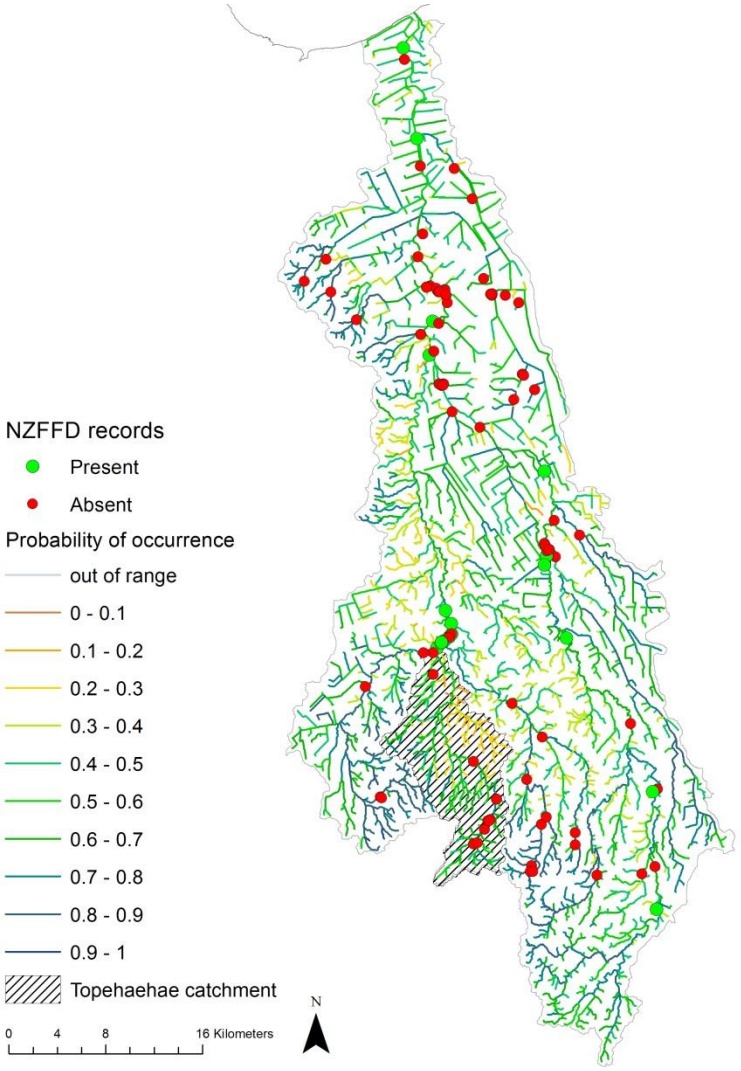

Figure 3.5: Presence and absence of longfin eels in the Piako catchment based on NZFFD records (Dec 2011).

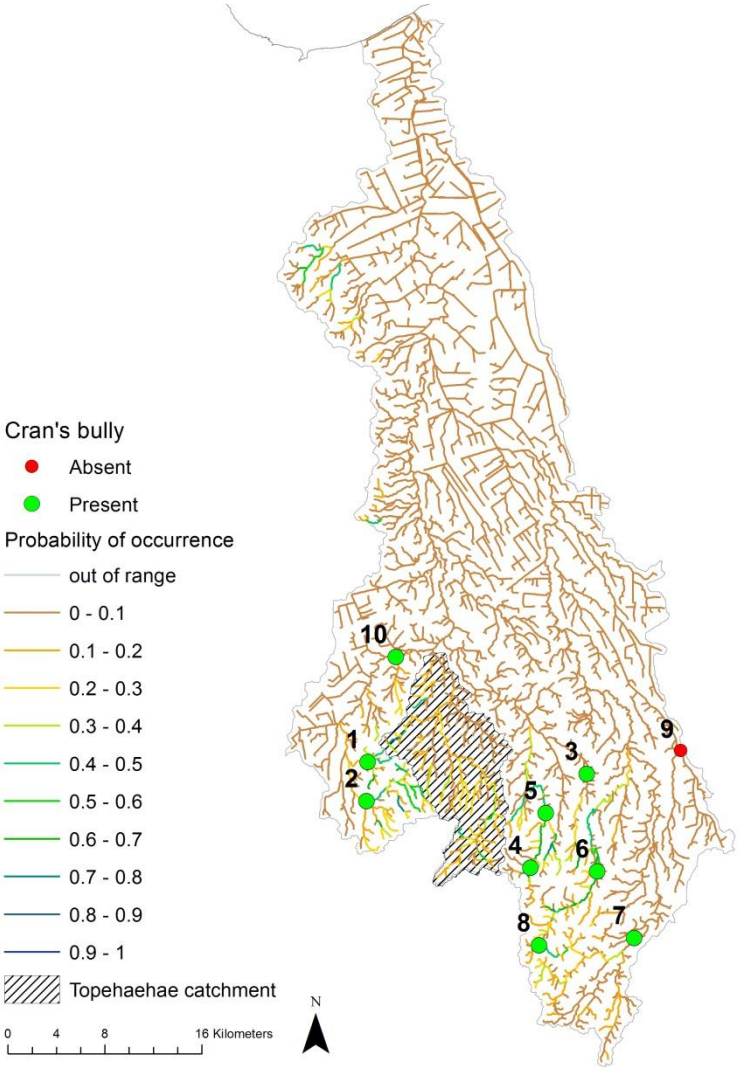

Figure 3.6: Presence and absence of Cran's bully during this survey relative to predicted probability of capture.

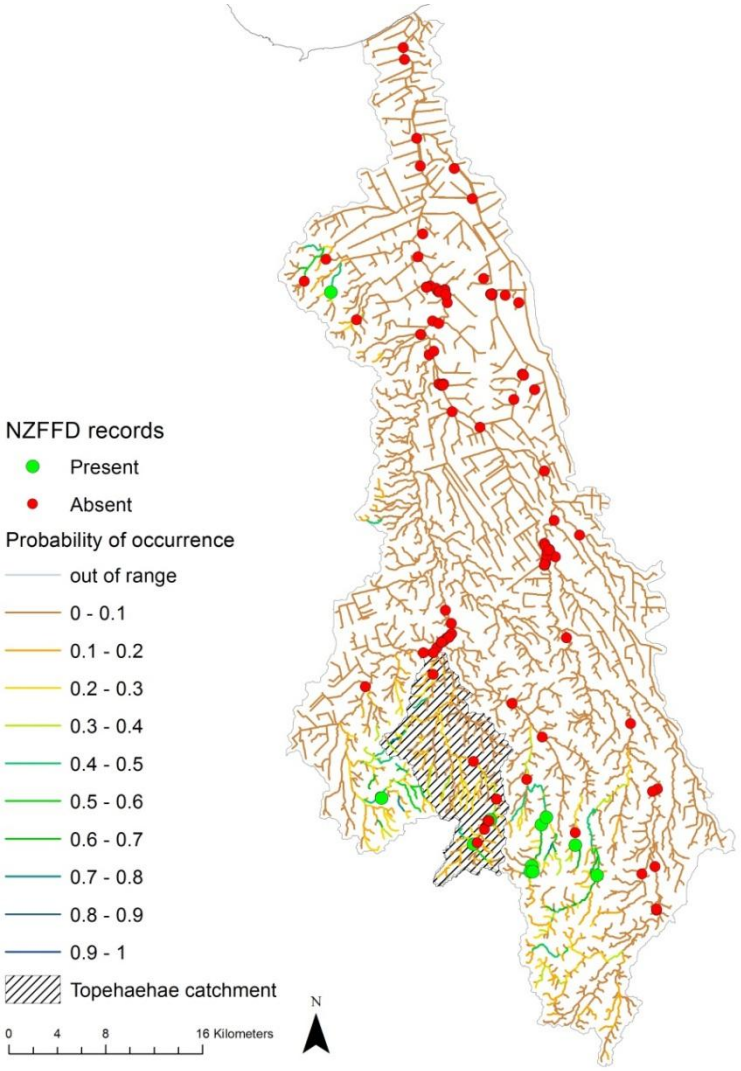

Figure 3.7: Presence and absence of Cran's bully in the Piako catchment based on NZFFD records (Dec 2011).

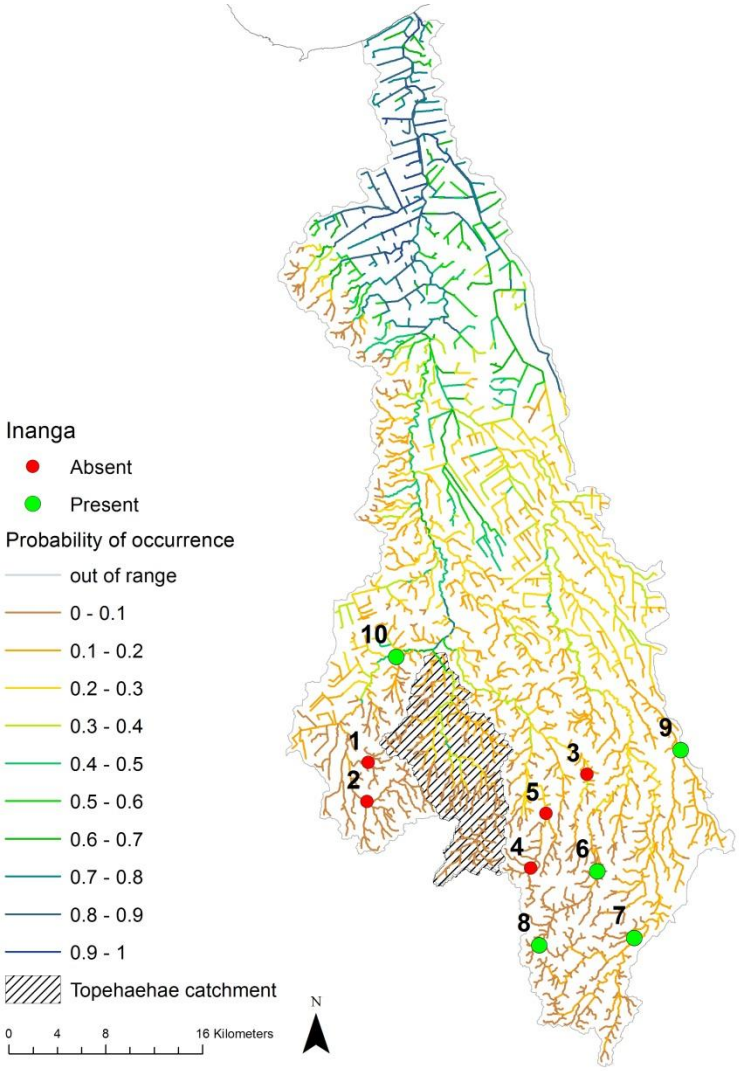

Figure 3.8: Presence and absence of inanga during this survey relative to predicted probability of capture.

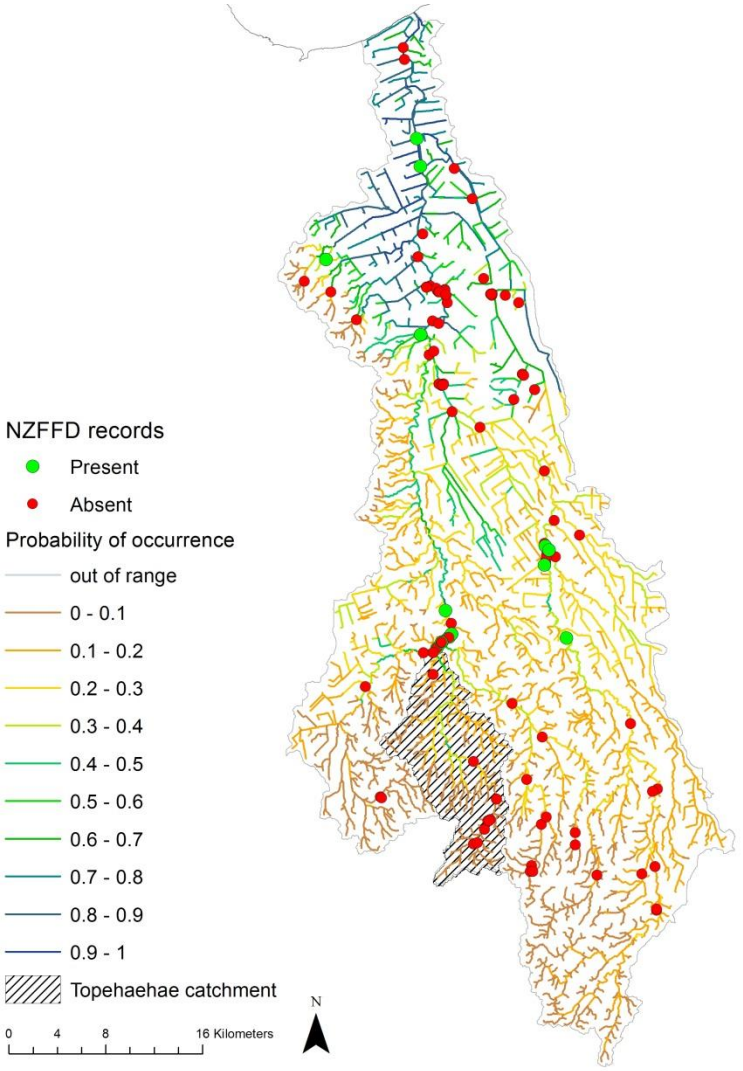

Figure 3.9: Presence and absence of inanga in the Piako catchment based on NZFFD records (Dec 2011).

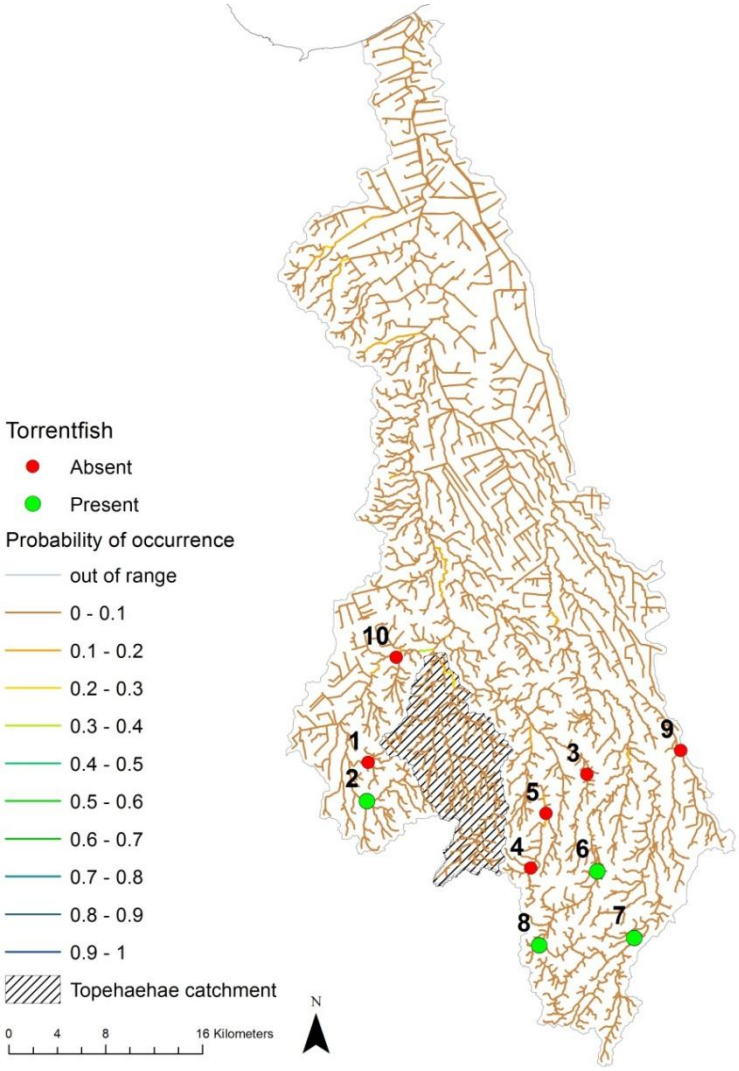

Figure 3.10: Presence and absence of torrentfish during this survey relative to predicted probability of capture.

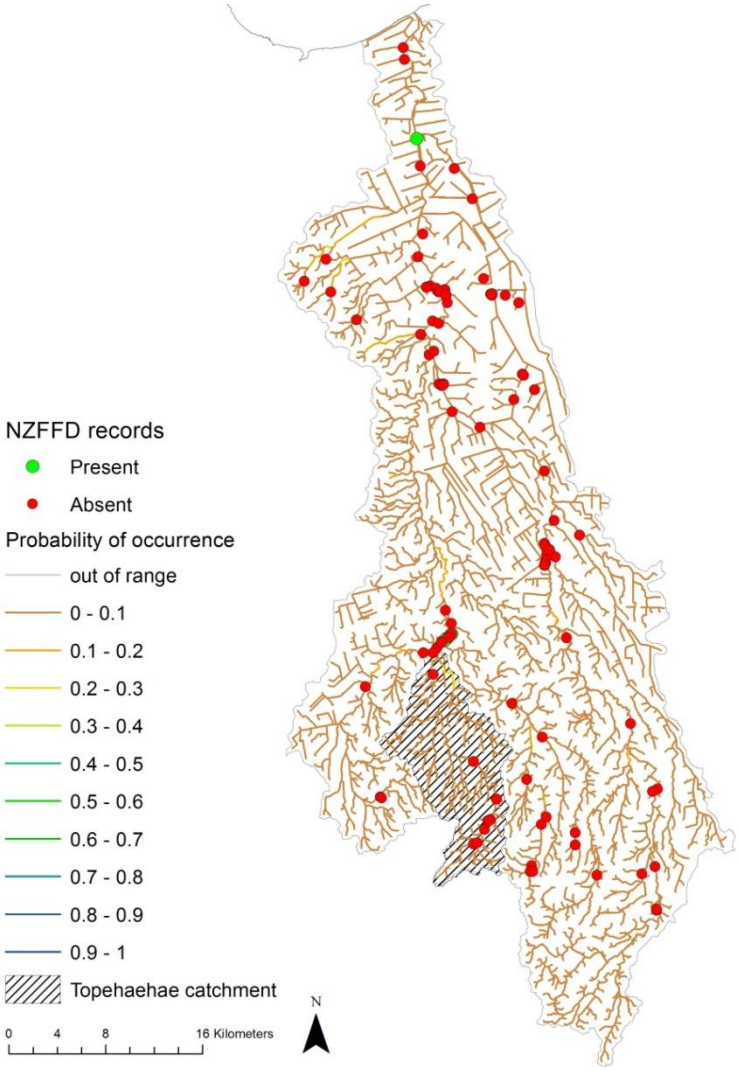

Figure 3.11: Presence and absence of torrentfish in the Piako catchment based on NZFFD records (Dec 2011).

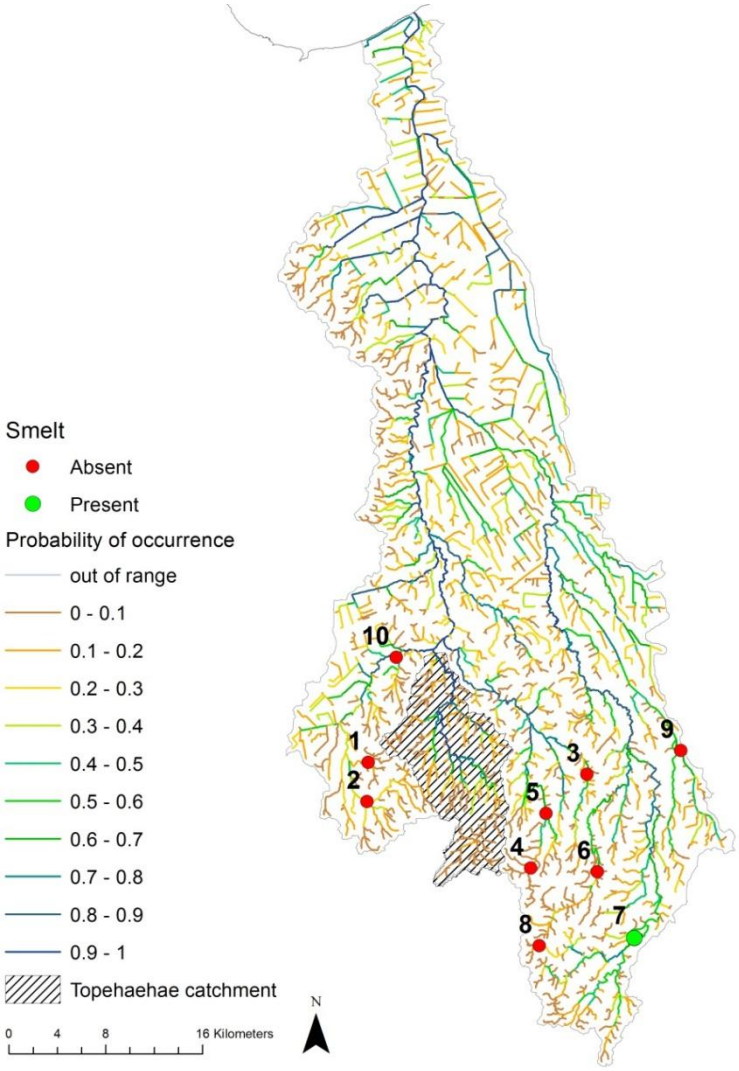

Figure 3.12: Presence and absence of smelt during this survey relative to predicted probability of capture.

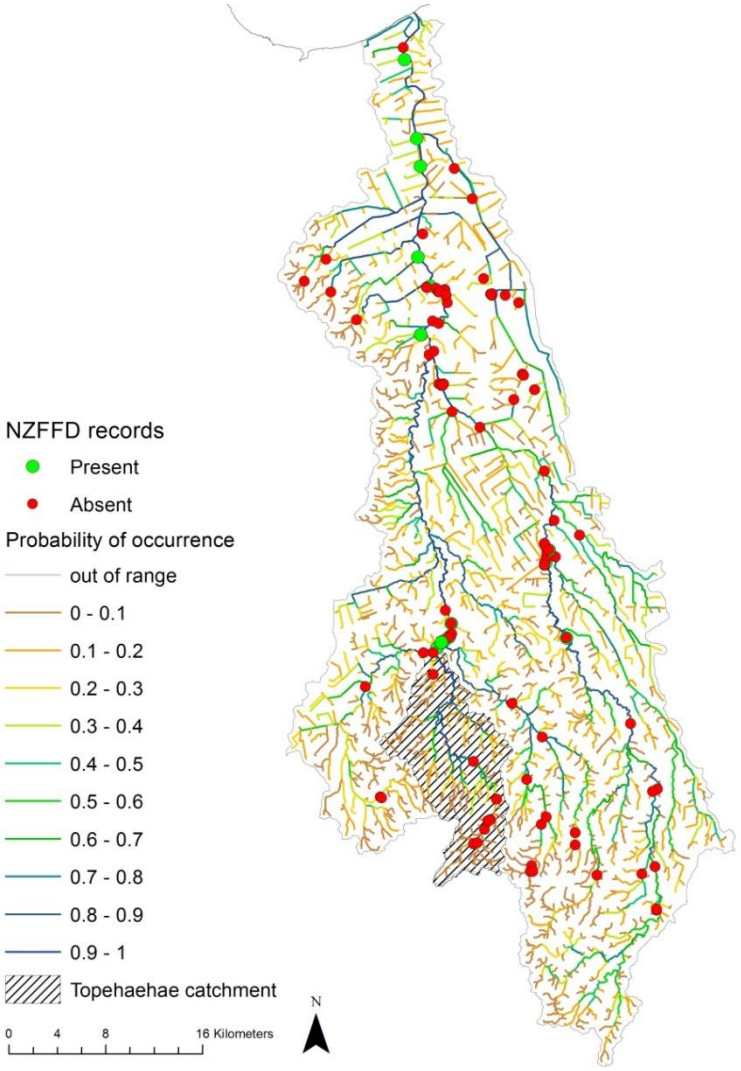

Figure 3.13: Presence and absence of smelt in the Piako catchment based on NZFFD records (Dec 2011).

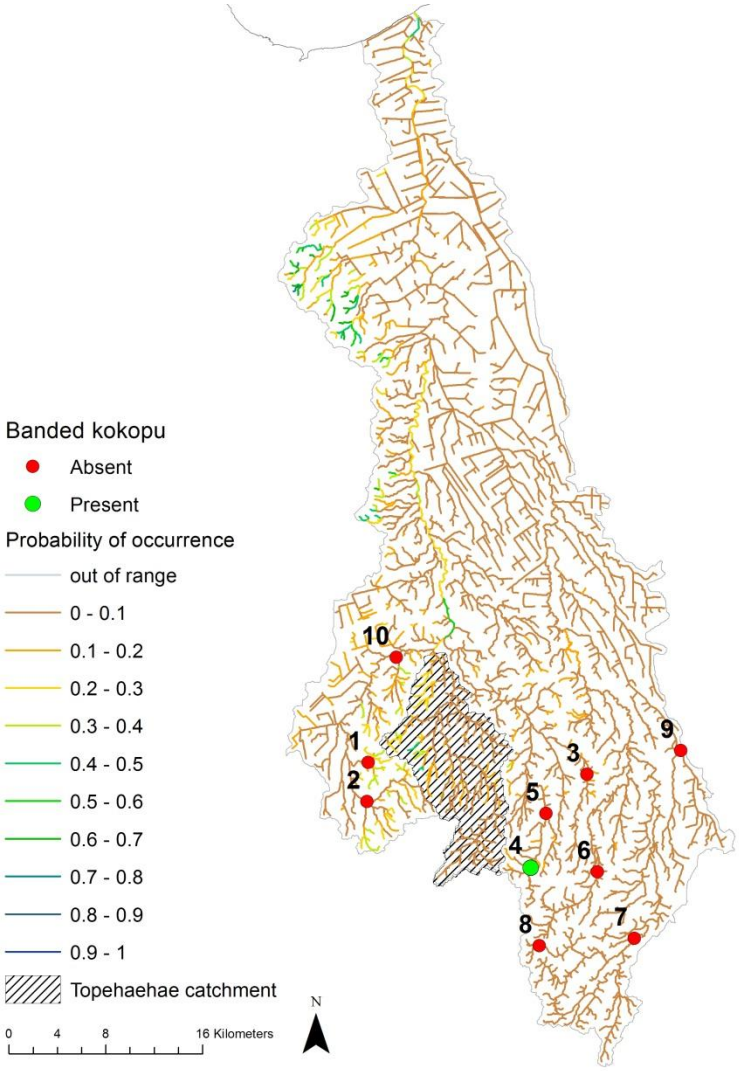

Figure 3.14: Presence and absence of banded kokopu during this survey relative to predicted probability of capture.

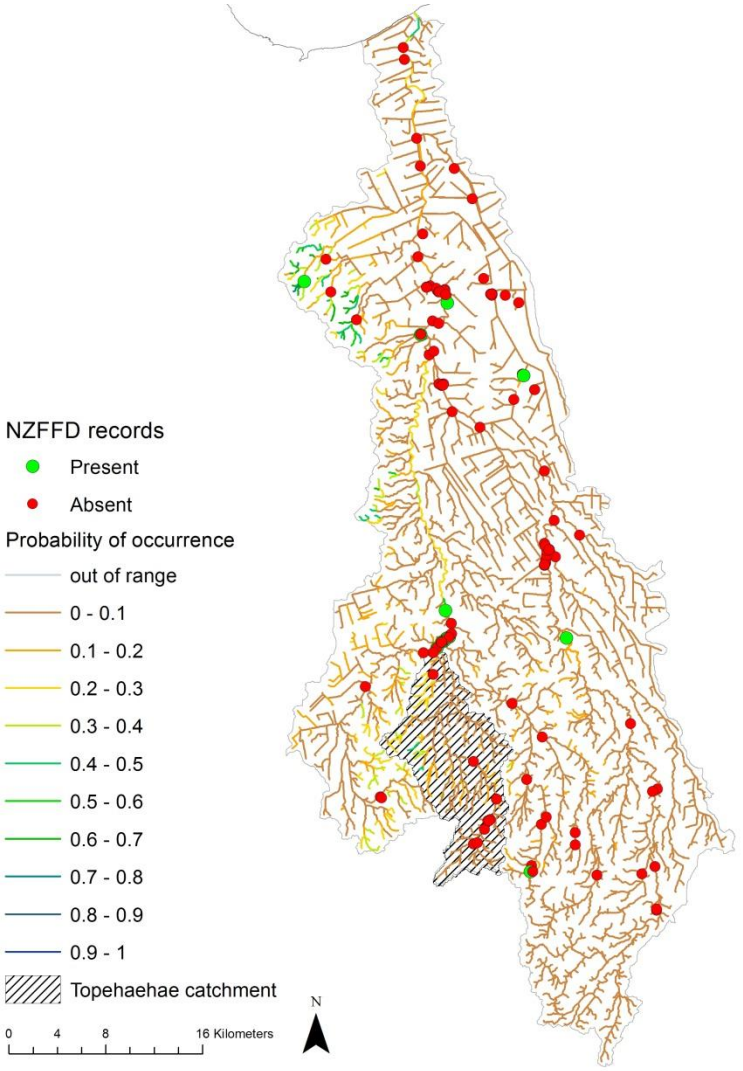

Figure 3.15: Presence and absence of banded kokopu in the Piako catchment based on NZFFD records (Dec 2011).

3.3 Macroinvertebrates

With the exception of Sites 3, 7, 9 and 10, sites were sampled according to MfE protocol C1 for hard-bottomed streams, with an area of approximately 1 m^2 sampled at each site. Sampling at the remaining sites followed MFE protocol C2 for soft-bottomed streams.

A full taxonomic list for each site is included in Appendix C and is summarised at the taxa level in Table 3-2 according to the methods of (Collier & Kelly 2005). Total taxa richness ranged from 10 at Site 10 to a maximum of 23 at the two Piakonui Stream sampling sites (Sites 4 and 5). Greatest taxa richness tended to occur in higher gradient streams with rocky substrates, whilst lower gradient, agricultural streams typically had lower taxa richness.

The presence and abundance of taxa from the Ephemeroptera, Plecoptera and Trichoptera (EPT) orders is generally considered an indicator of good habitat and water quality. EPT richness and %EPT (Table 3-2) are used to summarise the presence and significance of these taxa at a site. EPT richness varied from only three at Site 10 to sixteen at Site 4 (Table 3-2). Site 4 also had the highest %EPT score (96.6%). This reflects the relatively undisturbed nature of Site 4, which was a headwater stream with varied habitats and an intact, native riparian zone. The lowest %EPT scores were again mainly associated with the lower gradient, slower flowing more impacted streams (e.g., Sites 3, 9 and 10). This was reflected in significant positive correlations between %EPT and stream gradient ($r^2 = 0.39$; $p = 0.049$) and elevation ($r^2 = 0.48$; $p = 0.015$).

The Macroinvertebrate Community Index (MCI) was originally developed to indicate the tolerance of macroinvertebrate communities to organic pollution in hard-bottomed streams. Scores of less than 80 are classified as poor, those of 80-100 as fair, those of 100-120 as good and those of greater than 120 as excellent (Stark & Maxted 2007). Sites 3, 7, 9 and 10 were soft-bottomed streams, and thus some caution must be applied to interpreting the MCI scores for these sites.

Of the hard-bottomed sites, the lowest MCI score was recorded at Site 1 (95.8), with Site 6 (98.9) also falling into the 'fair' quality class. Site 4, located in native bush, again has the highest score (140.0) putting it into the 'excellent' quality class, along with Site 8 (121.0) in the headwaters of the Waitoa River. The remaining hard-bottomed sites were all in the 'good' quality class. Each of the four soft-bottomed streams (Sites 3, 7, 9, and 10) had lower MCI scores (Table 3-2), but this is expected to some degree due to the different nature of the habitats in these streams. The lowest score, and only site falling into the 'poor' quality class, was recorded for Site 9 on the Waihekau Stream (75.0). Whilst this was a soft-bottomed stream, it was also probably the most heavily impacted by channel modifications, homogenisation of instream habitats and poor water quality, and thus the MCI appears to give a reasonable indication of disturbance even in the soft-bottomed streams. MCI scores displayed statistically significant positive relationships with stream gradient ($r^2 = 0.65$; $p = 0.005$) and elevation ($r^2 = 0.59$; $p = 0.01$).

Table 3-2: Summary of macroinvertebrate results for the ten Piako monitoring sites in 2012.

Site	Total taxa richness	EPT richness	%EPT	MCI
1. Waitakaruru tributary 1	19	7	23.5	95.8
2. Waitakaruru Stream	13	7	33.8	104.6
3. Piakoiti Stream	16	5	12.8	93.8
4. Piakonui Stream u/s	23	16	96.6	140.0
5. Piakonui Stream d/s	23	12	57.7	103.5
6. Mangapapa Stream	19	13	21.7	98.9
7. Waitoa River	15	8	39.1	92.0
8. Waitoa headwaters	20	13	67.0	121.0
9. Waihekau Stream	16	4	4.70	75.0
10. Waitakaruru tributary 2	10	3	9.60	84.0

3.4 Macrophytes & periphyton

Macrophyte and periphyton cover varied significantly across the ten sites reflecting the differences in instream habitat, channel morphology and substrate types (Table 3-3; Table 3-4; Appendix D). Lower macrophyte cover (MTC ≤ 5) was primarily associated with rocky substrates (e.g., Sites 1, 4, 5, 6 and 8), which limit the capacity for rooted macrophytes to establish. Higher channel shading was also associated with lower macrophyte abundance (e.g., Sites 4 and 10). Higher macrophyte cover typified the lower gradient, slower flowing streams where riparian shading was sparse, for example Sites 3, 7 and 9. In these streams, the most commonly occurring species were *Potamogeton crispus*, *Egeria densa* and the marginal emergent *Persicaria hydropiper*, which are all introduced species. The only native macrophyte species recorded was *Nitella hookeri*, which was most common at Site 3.

The greatest abundance of macrophytes occurred in the Waihekau Stream (Site 9), where the MTC was 56 and MCC 33.5 (Table 3-3). This stream is low gradient, and the channel has been artificially deepened and widened. There is also no riparian shading as a result of the agricultural land use. High light availability, the silty substrate and elevated nutrient concentrations are likely the main drivers of the proliferation of macrophytes in this stream. The Piakoiti Stream also had a relatively high abundance of macrophytes, which is not fully captured by the MTC score of 10.2 (Table 3-3). The low MTC score reflects the need to select reaches with lower macrophyte abundance in order to maximise the efficiency of the electric fishing surveys. The reach that was selected for the survey benefited from a greater degree of shading, as a consequence of riparian planting carried out by the landowner, which resulted in lower instream macrophyte cover.

Periphyton abundance was relatively low at most sites (Table 3-4). The greatest periphyton cover occurred in the Waitoa River at Site 7 (PEI = 76.11), where filamentous algae were prevalent (PFI = 100). PSI is more strongly related to some of the macroinvertebrate indices than the other periphyton indices (Collier & Kelly 2005). The highest values for PPI were recorded for Sites 5 and 6 (30.25 and 30.40 respectively; Table 3-4), but neither site had particularly low %EPT or MCI scores (Table 3-2). It is suggested that the dominance of bedrock substrates at these two sites contributed to the higher PPI scores, due to the suitability of the smooth surface for colonisation by thin mats of algae.

Table 3-3: Summary of macrophyte indices for the ten Piako monitoring sites in 2012. MTC = Macrophyte Total Cover; MCC = Macrophyte Channel Clogginess; MNC = Macrophyte Native Cover.

Site	MTC	MCC	MNC
1. Waitakaruru tributary 1	3	2.3	0
2. Waitakaruru Stream	2	1.5	0
3. Piakoiti Stream	10.2	7.7	4.2
4. Piakonui Stream u/s	0	0	0
5. Piakonui Stream d/s	1.2	0.7	0
6. Mangapapa Stream	0	0	0
7. Waitoa River	19.2	13.8	3
8. Waitoa headwaters	5	5	0
9. Waihekau Stream	56	33.5	0
10. Waitakaruru tributary 2	2.1	1.1	2

Table 3-4: Summary of periphyton indices for the ten Piako monitoring sites in 2012. PEI = Periphyton Enrichment Index; PFI = Periphyton Filamentous Index; PMI = Periphyton Mat Index; PPI = Periphyton Proliferation Index; PSI = Periphyton Slimyness Index.

Site	PEI	PFI	PMI	PPI	PSI
1. Waitakaruru tributary 1	10.00	0	0	0	11.60
2. Waitakaruru Stream	10.00	0	0	0	3.80
3. Piakoiti Stream	0	0	0	0	0
4. Piakonui Stream u/s	10.00	0	0	0	2.50
5. Piakonui Stream d/s	35.26	7.02	0	7.02	30.25
6. Mangapapa Stream	44.94	15.10	3.27	18.37	30.40
7. Waitoa River	76.11	100.00	0	100.00	8.64
8. Waitoa headwaters	29.31	0	0	0	2.60
9. Waihekau Stream	0	0	0	0	0
10. Waitakaruru tributary 2	0	0	0	0	0

4 Discussion

Establishing long-term, regular ecological monitoring sites is critical to developing the understanding of natural variability in freshwater ecological communities that is essential for distinguishing and detecting human induced changes in aquatic ecosystems. The Piako catchment is widely acknowledged as being significantly impacted by land use change and the effects of agricultural development and intensification. The results of this study therefore already reflect the consequences of human induced changes on aquatic ecosystem structure and functioning.

In general, it is the low gradient, lowland streams that are subject to the greatest pressures from land use changes and intensification. This was evident in the structure of stream macroinvertebrate communities in the sites surveyed, with a lower proportion of desirable EPT taxa and lower MCI scores in lower elevation and lower gradient sites. These sites typically had more uniform habitats, more silty substrates, were slower flowing and had a greater abundance of aquatic macrophytes. Some also had warmer water temperatures and lower dissolved oxygen concentrations. The combination of these factors contribute to less species rich communities and lower frequency of occurrence of the more sensitive EPT taxa, which typically prefer faster flowing streams and more stable substrates.

The more mobile and migratory nature of most fish species means that the direct effects of habitat degradation at a site are more difficult to distinguish than for macroinvertebrates. However, they are beneficial as an indicator of the integrated effects of different stressors throughout a catchment. Because the sites included in this survey are all located in the upper catchment, the fish communities present reflect both local and downstream habitat and water quality conditions.

The most distinct pattern in the fish communities across the ten sites was the absence of inanga and torrentfish from the Piakoiti/Piakonui sub-catchment. This is most likely a consequence of a small waterfall on the Piako River just upstream of Morrinsville. Whilst species such as eels and banded kokopu are able to climb the waterfall, it is likely to be a barrier to migration for swimming species such as inanga, torrentfish, smelt and common bullies. The presence of torrentfish and inanga in the two other sub-catchments (Waitakaruru and Waitoa) indicates that downstream connectivity in these catchments is good.

More generally, shortfin eels dominated the fish communities in the upper catchment. This species is considered the most tolerant of modified habitats and lower water quality. Inanga and smelt are more sensitive to reductions in water quality and thus their presence in the Waitoa sub-catchment, albeit at lower abundances than eels, is an indicator that water quality during this summer season, was not a major limiting factor. This must however be considered in the context of the 2011-12 summer being wetter than average, meaning that river flows were higher and water quality potentially better than average due to higher dilution. There are also no reference sites in this catchment to compare the abundance of these species under unimpacted conditions. Smelt in particular were limited in distribution and abundance relative to the predicted probability of capture, which could indicate that with improved water quality, their abundance could be higher. These patterns will only become evident with long-term and regular monitoring.

Overall, instream habitats in the lowland, low gradient reaches were relatively homogenous and as a consequence ecological communities were simplified and dominated by more generalist species. A lack of riparian vegetation also contributes to warmer water temperatures and a greater abundance of instream macrophytes. In the steeper gradient streams, a greater diversity of instream habitats was maintained, but the lack of riparian vegetation means that water temperatures were noticeably higher than in the one site with intact riparian cover. There was also a much lower abundance of woody debris in these streams, which is an important habitat for both macroinvertebrates and native fish species.

It is therefore a combination of stressors, both physical and chemical, that appear to be the main drivers in determining the structure and functioning of ecological communities in the upper Piako catchment. Critical to determining instream flow requirements is developing an understanding of the extent to which these stressors are mediated or influenced by stream flow. Within the Piako catchment, critical issues affected by flow are likely to include assimilative capacity of the stream, connectivity at migration barriers under low flows, water temperatures, dissolved oxygen dynamics and physical habitat suitability.

5 Conclusion

The process of developing water allocation rules must be robust, transparent and based on clear, measureable objectives. The resulting water allocation framework must be sustainable and support adaptive management strategies. Reliable information on the status and dynamics of instream values is a key component in achieving this. Establishing and maintaining a routine ecological monitoring network allows the identification of values and develops an understanding of their status. This can be used to support development of appropriate management policies and as the length of the time series increases, allowing identification of trends and differences in community population dynamics over time and between sites, adaptive management strategies can be implemented.

6 References

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Appendix A Field and habitat assessment forms

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

Stream name: Waitakaruru Stream tributary		Assessor: Paul Franklin	
Site number: 1	Sample number:	Date: 13/2/12	Time: 12.20
GPS coordinates	Downstream:	E 2728090	N 6380572
	Upstream:	E 2728216	N 6380561

Channel & riparian features

Canopy cover:

Open | **Partly shaded** | Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 2.8m
Stream width (water): 2.8m
Stream depth: 0.3m
Surface velocity: 0.2m s^{-1}

Water quality

Temperature:	18.5	°C	Conductivity:	151	µS cm^{-1}
Dissolved oxygen:	95.7	%	8.96		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5% | **5-25%** | 26-50% | 51-75% | >75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	5
Cobble	>64-256mm	20
Gravel	>2-64mm	30
Sand	>0.06-2mm	15
Silt	0.004-0.06mm	30
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5**%** | **5-25%** | 26-50% | 51-75% | >75%

Coarse detritus (small wood, sticks, leaves etc.,. >1mm)

<5**%** | **5-25%** | 26-50% | 51-75% | >75%

Fine (<1mm) organic deposits

<5% | **5-25%** | 26-50% | 51-75% | >75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	60 %
Macrophyte:	%	Runs:	40%
Edges:	%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5% | 5-25% | 26-50% | 51-75% | >75%

Macrophytes:

<5% | **5-25%** | 26-50% | 51-75% | >75%

Mosses/liverworts:

<5% | 5-25% | 26-50% | 51-75% | >75%

Number of invertebrates returned:

Koura: rare	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waitakaruru Stream tributary	Site number: 1	
Sample number:	Assessor: Paul Franklin	Date:13/2/12

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• 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 bank8:	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	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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:13	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	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• 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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• 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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• 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	• >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					• 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					• 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					• <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	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 118.5																				

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

Stream name: Waitakaruru		Assessor: Paul Franklin	
Site number: 2	Sample number:	Date: 13/2/12	Time: 14.20
GPS coordinates	Downstream:	E 2727985	N 6377350
	Upstream:	E 2728142	N 6377272

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	Pasture	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel): 3m
Stream width (water): 2.5m
Stream depth: 0.3m
Surface velocity: 0.4m s^{-1}

Water quality

Temperature:	21.2	°C	Conductivity:	154	µS cm^{-1}
Dissolved oxygen:	104	%	9.21		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	**26-50%**	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	90
Sand	>0.06-2mm	5
Silt	0.004-0.06mm	5
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	**5-25%**	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100 %
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: common	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waitakaruru Stream	Site number: 2	
Sample number:	Assessor: Paul Franklin	Date:13/2/12

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• 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:9	20 19 18 17 16	15 14 13 12 11	10 **9** 8 7 6	5 4 3 2 1
Mean: 10.5				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• 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:10	20 19 18 17 16	15 14 13 12 11	**10** 9 8 7 6	5 4 3 2 1
Mean: 10				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• 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	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15	• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25	• 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	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted	• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent
Score:15	20 19 18 17 16	**15** 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat parameter	Category Optimal	Habitat parameter	Category Optimal	Habitat parameter
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low	• 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	• >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	• 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	• 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	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score:11	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrates	• Periphyton obvious & prolific • >20% cover of available substrates
Score: 17	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
TOTAL SCORE: 126.5				

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

Stream name: Piakoiti Stream		Assessor: Paul Franklin	
Site number: 3	Sample number:	Date: 14/2/12	Time: 10.00
GPS coordinates	Downstream:	E 2746139	N 6379564
	Upstream:	E 2746113	N 6379455

Channel & riparian features

Canopy cover:

Open	**Partly shaded**	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	**Exotic trees**	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):4m
Stream width (water): 3.5m
Stream depth: 0.5m
Surface velocity: 0.3m s^{-1}

Water quality

Temperature:	18.7	°C	Conductivity:	196	µS cm^{-1}
Dissolved oxygen:	83	%	7.7	mg l^{-1}	

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	**>75%**

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	5
Sand	>0.06-2mm	25
Silt	0.004-0.06mm	70
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	**26-50%**	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	%		
Wood:	%	Riffles:	%
Macrophyte:	50%	Runs:	100%
Edges:	50%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	**26-50%**	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Number of invertebrates returned:

Koura: occasional	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Soft-Bottomed Streams Qualitative Habitat Assessment Field Data Sheet																					
Stream name: Piakoiti Stream										Site number: 3											
Sample number:						Assessor: Paul Franklin										Date: 14/2/12					
Habitat parameter	Category																				
	Optimal					Suboptimal					Marginal					Poor					
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious					
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																					
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 7.5																					
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• Unstable • Many eroded areas • 60-100% of bank has erosional scars					
Left bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Right bank:11	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 11																					
4. Channel sinuosity	• Bends increase stream length 3-4 times longer than if it was straight					• Bends increase stream length 2-3 times longer than if it was straight					• Bends increase stream length 1-2 times longer than if it was straight					• Channel straight					
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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach Channelized & disrupted					• 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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• 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. Pool variability	• Pools evenly mixed • Large/shallow, large/deep, small/shallow, small/deep	• Majority of pools large/deep • Very few shallow pools	• Prevalence of shallow pools	• Majority of pools small/shallow
Score: 9	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	• >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	• 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	• 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	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
Score: 8	20 19 18 17 16	15 14 13 12 11	10 9 **8** 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments	• Periphyton not visible on substrates but obvious to touch	• Periphyton visible • <20% cover of available substrates	• 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:102.5				

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

Stream name: Piakonui Stream u/s		Assessor: Paul Franklin	
Site number: 4	Sample number:	Date: 14/2/12	Time: 14.00
GPS coordinates	Downstream:	E 2741486	N 6371826
	Upstream:	E 2741328	N 6371750

Channel & riparian features

Canopy cover:

Open	Partly shaded	**Very shaded**

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	Exotic trees	**Native trees**

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):3m
Stream width (water): 2.5m
Stream depth: 0.4m
Surface velocity: 0.3m s^{-1}

Water quality

Temperature:	15.5	°C	Conductivity:	89	µS cm^{-1}
Dissolved oxygen:	97	%	9.7		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	**26-50%**	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	30
Cobble	>64-256mm	50
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	20
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	**5-25%**	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	**5-25%**	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	**5-25%**	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100%
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: common	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Piakonui Stream u/s	Site number: 4	
Sample number:	Assessor: Paul Franklin	Date: 14/2/12

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• 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:16	20 19 18 17 **16**	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean: 18				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• Bank surfaces covered by grasses & shrubs • Disruption of stream bank vegetation very high • Grass heavily grazed • Significant stock damage to bank
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:17	20 19 18 **17** 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean: 18.5				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• Unstable • Many eroded areas • 60-100% of bank has erosional scars
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:19	20 **19** 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean: 19				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15	• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25	• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25
Score: 20	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
5. Channel alteration	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted	• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent
Score:20	**20** 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
Score: 17	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	• >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					• 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					• 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					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 16	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 15	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
TOTAL SCORE: 153.5																				

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

Stream name: Piakonui Stream d/s		Assessor: Paul Franklin	
Site number: 5	Sample number:	Date: 14/2/12	Time: 17.20
GPS coordinates	Downstream:	E 2742763	N 6376343
	Upstream:	E 2742808	N 6376201

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):4.5m
Stream width (water): 4m
Stream depth: 0.3m
Surface velocity: 0.4m s^{-1}

Water quality

Temperature:	20.7	°C	Conductivity:	107	µS cm^{-1}
Dissolved oxygen:	96	%	8.7		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	95
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	5
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100%
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: occasional	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams Qualitative Habitat Assessment Field Data Sheet																					
Stream name: Piakonui Stream d/s										Site number: 5											
Sample number:						Assessor: Paul Franklin									Date: 14/2/12						
Habitat parameter	Category																				
	Optimal					Suboptimal					Marginal					Poor					
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• 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:6	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Mean: 6																					
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• Bank surfaces covered by grasses & shrubs • Disruption of stream bank vegetation very high • Grass heavily grazed • Significant stock damage to bank					
Left bank:2	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: 3.5																					
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• 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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent					
Score:11	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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• 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	• >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					• 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					• 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					• <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	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• 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:100.5																				

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

Stream name: Mangapapa Stream		Assessor: Paul Franklin	
Site number: 6	Sample number:	Date: 15/2/12	Time: 11.00
GPS coordinates	Downstream:	E 2747006	N 6371508
	Upstream:	E 2746973	N 6371378

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):4m
Stream width (water): 3.5m
Stream depth: 0.25m
Surface velocity: 0.35m s^{-1}

Water quality

Temperature:	18.9	°C	Conductivity:	111	µS cm^{-1}
Dissolved oxygen:	93	%	8.7		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	95
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	5
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	**5-25%**	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100%
Macrophyte:	%	Runs:	%
Edges:	%		

Number of invertebrates returned:

Koura: occasional	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	**26-50%**	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Mangapapa Stream	Site number: 6	
Sample number:	Assessor: Paul Franklin	Date: 15/2/12

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• Breaks frequent • Human activity obvious				
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																				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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:14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 14																				
4. Frequency of riffles	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• 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	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• 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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
Score: 17	20	19	18	**17**	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	• >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					• 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					• 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					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 9	20	19	18	17	16	15	14	13	12	11	10	**9**	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• Periphyton obvious & prolific • >20% cover of available substrates				
Score: 12	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: Waitoa River		Assessor: Paul Franklin	
Site number: 7	Sample number:	Date: 15/2/12	Time: 13.00
GPS coordinates	Downstream:	E 2750045	N 6366003
	Upstream:	E 2749929	N 6365888

Channel & riparian features

Canopy cover:

Open | Partly shaded | Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	**Retired vegetation**
One side/partial	Pasture	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):5m
Stream width (water): 4m
Stream depth: 0.6m
Surface velocity: 0.3m s^{-1}

Water quality

Temperature:	19.4	°C	Conductivity:	155	µS cm^{-1}
Dissolved oxygen:	90	%	8.3		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5% | **5-25%** | 26-50% | 51-75% | >75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	20
Sand	>0.06-2mm	60
Silt	0.004-0.06mm	20
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5% | 5-25% | 26-50% | 51-75% | >75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5% | **5-25%** | 26-50% | 51-75% | >75%

Fine (<1mm) organic deposits

<5% | **5-25%** | 26-50% | 51-75% | >75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	%
Macrophyte:	%	Runs:	100%
Edges:	%		

Number of invertebrates returned:

Koura: common	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5% | **5-25%** | 26-50% | 51-75% | >75%

Macrophytes:

<5% | **5-25%** | 26-50% | 51-75% | >75%

Mosses/liverworts:

<5% | 5-25% | 26-50% | 51-75% | >75%

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waitoa River	Site number: 7	
Sample number:	Assessor: Paul Franklin	Date: 15/2/12

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• 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:13	20	19	18	17	16	15	14	**13**	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 13																				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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:10	20	19	18	17	16	15	14	13	12	11	**10**	9	8	7	6	5	4	3	2	1
Mean: 10																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• 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	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key					• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15					• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25					• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by stream width=>25				
Score: 11	20	19	18	17	16	15	14	13	12	**11**	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score:11	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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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. Velocity/depth regimes	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep					• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower					• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low					• Dominated by 1 velocity/depth regime • Usually deep/slow				
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	• >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					• 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					• 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					• <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	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch					• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch					• Periphyton visible • <20% cover of available substrates					• 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: 107																				

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

Stream name: Waitoa headwaters		Assessor: Paul Franklin	
Site number: 8	Sample number:	Date: 15/2/12	Time: 17.00
GPS coordinates	Downstream:	E 2742190	N 6365404
	Upstream:	E 2742003	N 6365272

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):3m
Stream width (water): 2m
Stream depth: 0.2m
Surface velocity: 0.4m s^{-1}

Water quality

Temperature:	18.3	°C	Conductivity:	130	µS cm^{-1}
Dissolved oxygen:	88	%	8.3		mg l^{-1}

Turbidity:	Clear	**Slightly turbid**	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	**5-25%**	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	5
Boulder	>256mm	15
Cobble	>64-256mm	65
Gravel	>2-64mm	10
Sand	>0.06-2mm	
Silt	0.004-0.06mm	5
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	**5-25%**	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	100%		
Wood:	%	Riffles:	100%
Macrophyte:	%	Runs:	%
Edges:	%		

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Number of invertebrates returned:

Koura: occasional	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Comments:

Wadeable Hard-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waitoa headwaters	Site number: 8	
Sample number:	Assessor: Paul Franklin	Date: 15/2/12

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• Breaks frequent • Human activity obvious
Left bank:10	20 19 18 17 16	15 14 13 12 11	**10** 9 8 7 6	5 4 3 2 1
Right bank:10	20 19 18 17 16	15 14 13 12 11	**10** 9 8 7 6	5 4 3 2 1
Mean: 10				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• Bank surfaces covered by grasses & shrubs • Disruption of stream bank vegetation very high • Grass heavily grazed • Significant stock damage to bank
Left bank:7	20 19 18 17 16	15 14 13 12 11	10 9 8 **7** 6	5 4 3 2 1
Right bank:7	20 19 18 17 16	15 14 13 12 11	10 9 8 **7** 6	5 4 3 2 1
Mean: 7				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• Unstable • Many eroded areas • 60-100% of bank has erosional scars
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:14	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	• Riffles relatively frequent • Distance between riffles divided by stream width=5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by stream width=7-15	• Occasional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by stream width=15-25	• 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	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach channelized & disrupted	• 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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends	• 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	• 4 velocity/depth regimes present • Slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 0f 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing, score low	• 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	• >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	• 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	• 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	• <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	• Periphyton not evident on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrates	• 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: 116.5				

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

Stream name: Waihekau Stream		Assessor: Paul Franklin	
Site number: 9	Sample number:	Date: 16/2/12	Time: 11.00
GPS coordinates	Downstream:	E 2753911	N 6381502
	Upstream:	E 2753991	N 6381373

Channel & riparian features

Canopy cover:

Open	Partly shaded	Very shaded

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	**Pasture**	Native shrub
Complete	Exotic trees	Native trees

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):4m
Stream width (water): 3.5m
Stream depth: 0.7m
Surface velocity: 0.35m s^{-1}

Water quality

Temperature:	17.5	°C	Conductivity:	145	µS cm^{-1}
Dissolved oxygen:	56	%	5.5		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	51-75%	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	
Sand	>0.06-2mm	90
Silt	0.004-0.06mm	10
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	5-25%	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	5-25%	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	%		
Wood:	%	Riffles:	%
Macrophyte:	50%	Runs:	100%
Edges:	50%		

Number of invertebrates returned:

Koura: occasional	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	**51-75%**	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Soft-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waihekau Stream	Site number: 9	
Sample number:	Assessor: Paul Franklin	Date: 16/2/12

Habitat parameter	Category: Optimal	Suboptimal	Marginal	Poor
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock • Mostly healed over	• Breaks frequent • Human activity obvious
Left bank:11	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1
Right bank:11	20 19 18 17 16	15 14 13 12 **11**	10 9 8 7 6	5 4 3 2 1
Mean: 11				
2. Vegetative protection	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• 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:8	20 19 18 17 16	15 14 13 12 11	10 9 **8** 7 6	5 4 3 2 1
Mean: 8.5				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• 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. Channel sinuosity	• Bends increase stream length 3-4 times longer than if it was straight	• Bends increase stream length 2-3 times longer than if it was straight	• Bends increase stream length 1-2 times longer than if it was straight	• Channel straight
Score: 2	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 **2** 1
5. Channel alteration	• Changes to channel/dredging absent/minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach Channelized & disrupted	• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent
Score:11	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	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• Heavy deposits of fine material • Increased bar development • >80% of bottom changing frequently • Pools almost absent due to sediment deposition				
Score: 12	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
7. Pool variability	• Pools evenly mixed • Large/shallow, large/deep, small/shallow, small/deep					• Majority of pools large/deep • Very few shallow pools					• Prevalence of shallow pools					• Majority of pools small/shallow				
Score: 2	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	• >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					• 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					• 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					• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes				
Score: 8	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
9. Periphyton	• Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments					• Periphyton not visible on substrates but obvious to touch					• Periphyton visible • <20% cover of available substrates					• 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: 83																				

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

Stream name: Waitakaruru Stream tributary		Assessor: Paul Franklin	
Site number: 10	Sample number:	Date: 16/2/12	Time: 13.10
GPS coordinates	Downstream:	E 2730406	N 6389244
	Upstream:	E 2730470	N 6389144

Channel & riparian features

Canopy cover:

Open	Partly shaded	**Very shaded**

Fencing:	Dominant riparian vegetation:	
None/ineffective	Crops	Retired vegetation
One side/partial	Pasture	Native shrub
Complete	Exotic trees	**Native trees**

Instream hydraulic conditions

Estimated or measured reach average:

Stream width (active channel):4m
Stream width (water): 2.5m
Stream depth: 0.4m
Surface velocity: 0.15m s^{-1}

Water quality

Temperature:	17.8	°C	Conductivity:	218	µS cm^{-1}
Dissolved oxygen:	83	%	7.9		mg l^{-1}

Turbidity:	**Clear**	Slightly turbid	Highly turbid	Stained	Other

Stream-bottom substrata

Compaction (inorganic substrata):

Assorted sizes tightly packed &/or overlapping
Moderately packed with some overlapping
Mostly a loose assortment with little overlap
No packing/loose assortment easily moved

Embeddedness:

(% gravel-boulder particles covered by fine sediment)

<5%	5-25%	26-50%	**51-75%**	>75%

% surficial inorganic substratum size composition:

Substratum	Dimension	Percentage
Bedrock	-	5
Boulder	>256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	10
Sand	>0.06-2mm	55
Silt	0.004-0.06mm	30
Clay	<0.004mm	

Organic material (% cover)

Large wood (>10cm diameter)

<5%	**5-25%**	26-50%	51-75%	>75%

Coarse detritus (small wood, sticks, leaves etc., >1mm)

<5%	**5-25%**	26-50%	51-75%	>75%

Fine (<1mm) organic deposits

<5%	5-25%	26-50%	51-75%	>75%

Habitat types sampled

(% of effort)

Stones:	%		
Wood:	50%	Riffles:	%
Macrophyte:	%	Runs:	100%
Edges:	50%		

Number of invertebrates returned:

Koura: common	Shrimps:
Crabs:	Mussels:
Other:	
Mussel type:	
Hyridella	*Cucumerunio*

Instream plant cover (% streambed area)

Filamentous algae & mats:

<5%	5-25%	26-50%	51-75%	>75%

Macrophytes:

<5%	5-25%	26-50%	51-75%	>75%

Mosses/liverworts:

<5%	5-25%	26-50%	51-75%	>75%

Comments:

Wadeable Soft-Bottomed Streams
Qualitative Habitat Assessment Field Data Sheet

Stream name: Waitakaruru Stream tributary	Site number: 10	
Sample number:	Assessor: Paul Franklin	Date: 16/2/12

Habitat parameter	Category																			
	Optimal					Suboptimal					Marginal					Poor				
1. Riparian vegetative zone width	• Bankside vegetation buffer >10m • Continuous & dense					• Bankside vegetation buffer is <10m • Mostly continuous					• Pathways present and/or stock • Mostly healed over					• 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	• Bank surfaces & immediate riparian zones covered by native vegetation • Trees, under-storey shrubs or non-woody plants present • Vegetative disruption minimal					• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry					• Bank surfaces covered by mixture of grasses/shrubs, blackberry, willow & introduced species • Vegetation disruption obvious • Bare soil/closely cropped vegetation common					• 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:17	20	19	18	**17**	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 17																				
3. Bank stability	• Banks stable • Erosion/bank failure absent/minimal • <5% of bank affected					• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded					• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods					• Unstable • Many eroded areas • 60-100% of bank has erosional scars				
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:14	20	19	18	17	16	15	**14**	13	12	11	10	9	8	7	6	5	4	3	2	1
Mean: 12.5																				
4. Channel sinuosity	• Bends increase stream length 3-4 times longer than if it was straight					• Bends increase stream length 2-3 times longer than if it was straight					• Bends increase stream length 1-2 times longer than if it was straight					• Channel straight				
Score: 11	20	19	18	17	16	15	14	13	12	**11**	10	9	8	7	6	5	4	3	2	1
5. Channel alteration	• Changes to channel/dredging absent/minimal • Stream with normal pattern					• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present					• Channel changes/dredging extensive • Embankments/shoring structures present on both banks • 40-80% of reach Channelized & disrupted					• Banks shored with gabion/cement • >80% of stream reach channelized or disrupted • Instream habitat altered/absent				
Score: 15	20	19	18	17	16	**15**	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Habitat parameter	Category Optimal					Habitat parameter					Category Optimal					Habitat parameter				
6. Sediment deposition	• Little/no islands or point bars present • <20% of bottom affected by sediment deposition					• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of bottom affected • Slight deposition in pools					• Some deposition of new gravel, sand or fine sediment on old & new bars • 50-80% of bottom affected • Sediment deposits at obstructions, constrictions & bends					• 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. Pool variability	• Pools evenly mixed • Large/shallow, large/deep, small/shallow, small/deep					• Majority of pools large/deep • Very few shallow pools					• Prevalence of shallow pools					• Majority of pools small/shallow				
Score: 14	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
8. Abundance & diversity of habitat	• >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					• 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					• 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					• <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	• Periphyton not evident on hand held substrates (macrophytes, wood etc.,) or fine sediments					• Periphyton not visible on substrates but obvious to touch					• Periphyton visible • <20% cover of available substrates					• 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: 129																				

Appendix B Fish surveys

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2728090 N6380572 GPS (u/s): E2728216 N6380561	Site: Waitakaruru Stream tributary	Date: 13/02/12

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished
		X (highlighted)			

Fish sample id:	Total shock time (min): 65	Fishing time: Start 9:45 Finish 12:10	Sample distance (m): 150

Wetted width (m):	A 2.9	C 3.2	E 4.3	G 2.3	I 2.4
	B 3.1	D 1.4	F 1.6	H 2.5	J 1.0

Sampling gear:	Spotlight	EFM (highlighted)	Seine	Length (m) / Mesh (mm)	Water visibility:	Good (highlighted)	Average	Poor	Water temp. (°C): 18.5	Conductivity (µS): 151

EFM anode: Big (highlighted) / Small	EFM volts (x100): 3	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	10	12	12	10	8	5	14	5	4	9	89		84	680	
Longfin eel		1					1		1		3		480	1100	
Cran's bully	27	21	10	11	8	11	9	5	11	1	114		22	81	
Koura		1				1									

FLAG	Comment	FLAG	Comment
1	Reach I: 2*3m too deep to fish		
2	Reach J: 4*3m too deep to fish		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA); Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E 2727985 N6377350	Site: Waitakaruru Stream		Date: 13/2/12
	GPS (u/s): E2728142 N6377272	Not fished	Fished none collected	Fished 10 sub-reaches
		Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished

Fish sample id:	Total shock time (min): 65	Fishing time: Start 13:20 Finish 15:40	Sample distance (m): 150

Wetted width (m):									
A	3.2	C	2.8	E	2.3	G	2.5	I	2.5
B	2.4	D	1.4	F	3.7	H	2.2	J	2.4

Sampling gear:	Spotlight	EFM	Seine	Length (m)	Mesh (mm)
Water visibility:	Good	Average	Poor	Water temp. (°C): 21.2	Conductivity (µS): 154
EFM anode: Big / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):	

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Cran's bully	9	7	5	15	9	20	8	12	6	6	97		24	65	
Shortfin eel	25	13	20	15	15	14	15	14	12	11	154		85	720	
Torrentfish	1				2						3		65	115	
Koura		2	2	2	2		3	3	6	6	26				
Longfin eel				1	5			1	1		8		186	900	
Gambusia								1	1	3	5		22	36	

FLAG	Comment	FLAG	Comment

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA); Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2746139 N6379564	Site: Piakoiti Stream		Date: 14/2/12
	GPS (u/s): E2746113 N6379455			

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished
		(selected)			

Fish sample id:	Total shock time (min): 81	Fishing time: Start 9:53 Finish 12:10	Sample distance (m): 150	Wetted width (m): A 2.8 C 2.4 E 1.8 G 1.6 I 1.7; B 1.8 D 1.8 F 2.4 H 1.8 J 3.2
Sampling gear: Spotlight / **EFM** (selected) / Seine; Length (m) / Mesh (mm)	Water visibility: **Good** (selected) / Average / Poor	Water temp. (°C): 18.7	Conductivity (µS): 196	
EFM anode: **Big** (selected) / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):

Species	A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Length (mm) Max.	FLAG
Shortfin eel	17	34	34	21	19	23	24	9	15	29	225		110	660	
Cran's bully	8	5	1	1	0	0	0	1	0	0	16		30	66	
Koura		3	2	2		1	2	2	1	2	15				

FLAG	Comment	FLAG	Comment
F1	Fished reach A (corner by road -u/s) then skipped c.50m before Reach B. Too deep and vegetation		
F2	Missing eels due to water pepper cover * 20 missed SF 100-650mm		
F3	Water pepper missed 8 SF		
F4	6 eels missed 200-650		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2741486 N6371826 GPS (u/s): E2741328 N6371750	Site: Piakonui Stream u/s				Date: 14/2/12
		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): 58	Fishing time: Start 13:15 Finish 15:10	Sample distance (m): 150	Wetted width (m):	A	2.4	C	1.8	E	1	G	2.1	I	3.1
					B	2.4	D	2.2	F	4.3	H	1.2	J	3.7

Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 15.2	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 A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Koura	9	10	8	16	20	10	5	10	6	12	106				
Shortfin eel	2	2	0	0	0	1					5		100	180	
Banded kokopu	1										1		192		
Longfin eel		1		1	2				1	1	6		530	1000	
Cran's bully			1								1		45		

FLAG	Comment	FLAG	Comment
F1	Reach I: stopped at 130m and skipped c.15m due to deep pool not fishable, restarted at next riffle.		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2742763 N6376343 GPS (u/s): E2742808 N6376201	Site: Piakonui Stream d/s		Date: 14/2/12

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished
		(highlighted)			

Fish sample id:	Total shock time (min): 67	Fishing time: Start 16:00 Finish 17:10	Sample distance (m): 150	Wetted width (m):

Wetted width (m)	A	B	C	D	E	F	G	H	I	J
	4.5	3.5	3.4	3.7	2.7	3.2	4.0	3.6	4.5	2.3

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 20.7	Conductivity (µS): 107

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 A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Longfin eel	2		1	3		1	2	1	4	12	26		106	900	
Shortfin eel	21	19	3	6	7	14	10	12	14	10	116		83	600	
Cran's bully	3	2	5	1	3	5	3	1	1	2	26		20	79	
Koura	1	3	7		1	1	6	2	10	3	34				
Shrimp - occasional															

FLAG	Comment	FLAG	Comment

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2747006 N6371508 GPS (u/s): E2746973 N6371378	Site: Mangapapa Stream				Date: 15/2/12
		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 9:45 Finish 12:10	Sample distance (m): 150	Wetted width (m):	A	3.7	C	3.2	E	4.1	G	3.9	I	4.0
					B	4.3	D	3.6	F	5.3	H	4.3	J	4.8

Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 18.9	Conductivity (µS): 111

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 A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	5	4	10	10	9	20	12	14	18	14	116		76	550	
Koura	2	1	4	6	2		1		2	3	21				
Cran's Bully	2	11	9	11	6	3	13	5	11	20	91		23	69	
Torrentfish			1			1					2		69	114	
Longfin eel	1			1	1	1			1	1	6		152	600	
Unidentified eel				2							2				
Inanga	2				1	1					4		64	134	

FLAG	Comment	FLAG	Comment

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2750045 N6366003 GPS (u/s): E2749929 N6365888	Site: Waitoa River				Date: 15/2/12	
		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): 89	Fishing time: Start 13:00 Finish 14:24	Sample distance (m): 150	Wetted width (m): A 3.3, C 3.2, E 4.3, G 3.8, I 3.6; B 4.8, D 3.2, F 5.0, H 4.3, J 3.1

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 19.4	Conductivity (µS): 155

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 A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	17	21	14	23	35	16	15	26	22	20	209		70	800	
Cran's bully	13	10	4	2	6	9	3	8	5	2	62		15	70	
Koura	4	1	1	5	3	6	4	5	1	3	33				
Longfin eel	1		1								2		450	700	
Gambusia	1	1	2			1	3			2	10		20	45	
Smelt		2									2		80	80	
Torrentfish						3		1			4		25	60	
Inanga									1		1		75		
Shrimp - present											0				

FLAG	Comment	FLAG	Comment
F1	2*4m not fished, too deep		
F2	4*6m not fished, too deep		
F3	50-100m approx. skipped		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2742190 N6365404 GPS (u/s): E2742003 N6365272	Site: Waitoa River			Date: 15/2/12
		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): 51	Fishing time: Start 15:00 Finish 17:00	Sample distance (m): 150	Wetted width (m):	A	1.9	C	1	E	1.5	G	1.2	I	1.1
					B	1.5	D	1.9	F	1.8	H	1.6	J	1.3

Sampling gear:	Spotlight	EFM	Seine	Length (m) Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 18.3	Conductivity (µS): 130		
EFM anode: Big / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):								

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	26	34	38	33	33	18	21	16	3	32	254		80	600	
Koura	9	3	4	1	14	3	2	2	3	3	44				
Longfin eel	2		1	1	1				1		6		150	980	
Cran's bully	12	8	18		24						62		20	84	
Inanga			1								1		141	141	
Torrentfish				2	1						3		85	136	

FLAG	Comment	FLAG	Comment
F1	Fished 75m d/s of bridge A-E and 75m u/s (F-J) of waterfall just above bridge.		

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA) Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2753911 N6381502	Site: Waihekau Stream				Date: 16/2/12
	GPS (u/s): E2753991 N6381373	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): 92	Fishing time: Start 09:30 Finish 10:50	Sample distance (m): 150	Wetted width (m): A 3.3, C 3.5, E 3.1, G 3.3, I 3.1; B 2.9, D 3.2, F 3.5, H 4.0, J 2.7

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 17.5	Conductivity (µS): 145	

EFM anode: Big / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	5	1	3	9	11	13	10	11	10	6	79		90	700	
Koura	2	4	4		1	2	2	1			16				
Inanga		2	2	1	1		1	5	2	2	11		69	130	
Gambusia			1					1			2		20	25	

FLAG	Comment	FLAG	Comment

Fish collection form – Wadeable streams/rivers

Team members: Paul Franklin (NIWA); Josh Smith (NIWA); Brenda Aldridge (NIWA)	GPS (d/s): E2730406 N6389244	Site: Waitakaruru Stream tributary		Date: 16/2/12
	GPS (u/s): E2730470 N6389144			

Not fished	Fished none collected	Fished 10 sub-reaches	Fished 5-9 sub-reaches	Fished <5 sub-reaches	FLAG for fished/not fished
		X (highlighted)			

Fish sample id:		Total shock time (min):	50	Fishing time:	Start 12:00	Finish 13:20	Sample distance (m):	150	Wetted width (m):	A 2.8 / B 3.2	C 3.3 / D 1.8	E 2.6 / F 2.2	G 2.5 / H 2.5	I 3.1 / J 2.2

Sampling gear:	Spotlight	EFM	Seine	Length (m) / Mesh (mm)	Water visibility:	Good	Average	Poor	Water temp. (°C): 17.8	Conductivity (µS):	218

EFM anode: Big / Small	EFM volts (x100): 2	EFM pulse rate (Hz or pps): 60	EFM pulse width (ms): 2	Spotlight (watts):

Species	Sub-reach tally A	B	C	D	E	F	G	H	I	J	Total count	Sample count	Length (mm) Min.	Max.	FLAG
Shortfin eel	1	8	6	5	6	10	12	8	7	6	69		60	680	
Koura	4	7	5	7	7	5	4	7	6	2	54				
Cran's Bully	7	27	18	19	35	9	20	28	11	4	178		15	70	
Gambusia		2					2	1			5		15	60	
Inanga					1						1		75	75	

FLAG	Comment	FLAG	Comment

Appendix C Macroinvertebrate taxa list

Species	Sites									
	1	2	3	4	5	6	7	8	9	10
ODONATA										
Austrolestes colensonis			1							
Xanthocnemis zealandica	1		35			1			4	1
HEMIPTERA										
Microvelia sp.	1		1		1					
Sigara sp.									6	
COLEOPTERA										
Elmidae	1	34	1	1	10	9	61	15	1	
Hydraenidae				1						
Hydrophilidae								1		
Liodessus sp.									3	1
Ptilodactylidae				2						
Rhantus sp.									1	
EPHEMEROPTERA										
Acanthophlebia cruentata				1						
Austroclima sepia	25	16	8	96	51	9	42	42		
Coloburiscus humeralis				101						
Deleatidium spp.		1		101	2		1	300		
Ichthybotus hudsoni				1						
Mauiulus luma						3	1			
Neozephlebia scita				1						
Nesameletus sp.				9						
Zephlebia borealis				5						
Zephlebia dentata	3	8	12	105	14	3	57	112		5
Zephlebia inconspicua						1				
PLECOPTERA										
Austroperla cyrene				3						
Megaleptoperla diminuta				7					1	
TRICHOPTERA										
Aoteapsyche catherinae						2				

Species	Sites									
	1	2	3	4	5	6	7	8	9	10
Aoteapsyche colonica	100	38	1		3	2	17	23	1	
Aoteapsyche raruraru					150	2		1		
Costachorema sp.				1	2	2		2		
Hudsonema alienum					3	4				
Hudsonema amabile	2				9	7		1		
Hydrobiosella stenocerca				14						
Hydrobiosis sp.	8	1	3	3	8	1	2	8		1
Neurochorema sp.					5	2				
Oecetis unicolor							1			
Olinga feredayi								37		
Orthopsyche sp.				34	1					
Oxyethira albiceps		3		1	8	92	42		8	
Paroxyethira sp.						1				
Polyplectropus sp.								1		
Psilochorema sp.								1		
Pycnocentria evecta						3		1		
Pycnocentrodes sp.	6	28			136	50	49	57		
Triplectides obsoletus/dolichos	39		77		5	20		2	1	27
Zelolessica cheira				2						
MEGALOPTERA										
Archichauliodes diversus		1			1			8		
DIPTERA										
Aphrophila neozelandica	7	2		1	8	2		3		
Austrosimulium sp.	20	40	136	1	3		12	10	23	51
Chironominae		1		5	12	225	1		43	4
Lobodiamesa sp.					1	32				
Maoridiamesa sp.	1	2			171	240	3	2	1	
Muscidae					3					
Orthocladiinae	4	3		4	60	816	9		29	1
Paradixa sp.	1		1		1					
Psychodidae									1	
Sciomyzidae	1									

Species	Sites									
	1	2	3	4	5	6	7	8	9	10
Tanyderidae										1
Tanytarsini	1	1					3			
Zelandotipula sp.	1									
LEPIDOPTERA										
Hygraula nitens							2			
OLIOGOCHAETA	60					1	2		20	1
HIRUDINEA			6						3	
MOLLUSCA										
Gyraulus sp.									1	
Latia neeritoides					1			2		
Physa acuta			4				1		9	
Potamopyrgus antipodurum	VVA	108	VVA	6	VA	VVA	VA	VA	105	VA
Sphaeridae	3		1							
CRUSTACEA										
Ostracoda			1		1				5	
Paracalliope fluviatilis	57	7	180		93	6	2			3
ACARI	1									1

Appendix D Macrophytes and periphyton

Periphyton Assessment							
Stream: Waitakaruru Stream tributary		Date: 13/2/12					
Sample Number: Piako Site 1		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA	15	30	20	20	30	23
Medium mat/film (0.5-3mm thick)	Green (% cover)						0
	Light brown (% cover)						0
	Black/dark brown (% cover)		10	10	15		11.6
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)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA				2		2
Iron Bacteria growths	NA						0

Macrophyte recording sheet											
Stream: Waitakaruru Stream tributary			**Located number**:				**Sample Number**: Piako Site 1			**Date**: 13/2/12	
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	2.6	3	0							
2	2.5	4	10	7			7	Pk	3	2 Na 1 Ph
3	1.4	1.6	2						2	Ph
4	2.2	2.2	3						3	Ph
5	2.3	2.8	0							

Periphyton Assessment							
Stream: Waitakaruru Stream		Date: 13/2/12					
Sample Number: Piako Site 2		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA	5	0	0	5	10	4
Medium mat/film (0.5-3mm thick)	Green (% cover)						0
	Light brown (% cover)						0
	Black/dark brown (% cover)					5	5
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: Waitakaruru Stream			**Located number**:				**Sample Number**: Piako Site 2			**Date**: 13/2/12	
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	2.1	0							
2	1.0	2.0	0							
3	2.4	3.5	0							
4	2.4	2.6	0							
5	2.3	2.8	10	10	5	Ed	5	Ed		

Periphyton Assessment							
Stream: Piakoiti Stream		Date: 14/2/12					
Sample Number: Piako Site 3		Located number:					
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: Piakoiti Stream			**Located number**:				**Sample Number**: Piako Site 3		**Date**: 14/2/12	
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	2.75	3	21	16			16	Nh 15 Ed <1 Pk <1	5	Ph
2	1.8	2.5	12	2			2	Pk	10	Ph
3	2.4	2.8	6	1			1	Nh	5	Ph
4	2.4	3.0	8	3			3	Nh 2 Pk 1	5	Ph
5	3.2	3.5	4	3			3	Nh	1	Ph

Periphyton Assessment							
Stream: Piakonui Stream u/s		Date: 14/2/12					
Sample Number: Piako Site 4		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA	10		5	5	30	12.4
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	5	2	5	10	5	5.4
Iron Bacteria growths	NA						0

Macrophyte recording sheet											
Stream: Piakonui Stream u/s			**Located number**:				**Sample Number**: Piako Site 4			**Date**: 14/2/12	
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	2.4	3.5	0							
2	2.35	3.0	0							
3	0.95	1.5	0							
4	4.3	5.5	0							
5	1.15	4.0	0							

Periphyton Assessment							
Stream: Piakonui Stream d/s		Date: 14/2/12					
Sample Number: Piako Site 5		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA	30	30	15		10	21.25
Medium mat/film (0.5-3mm thick)	Green (% cover)						0
	Light brown (% cover)			30	10	20	20
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)		20			30	25
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)		5				5
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte recording sheet											
Stream: Piakonui Stream d/s			**Located number**:				**Sample Number**: Piako Site 5			**Date**: 14/2/12	
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	4.8	0							
2	3.7	4.0	0							
3	2.7	3.0	0							
4	3.2	3.5	5	5			5	Ed		
5	3.6	3.8	1						1	Ph

Periphyton Assessment							
Stream: Mangapapa Stream		Date: 15/2/12					
Sample Number: Piako Site 6		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA	10					10
Medium mat/film (0.5-3mm thick)	Green (% cover)						0
	Light brown (% cover)		15	15	15	15	15
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)			2			2
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)					5	5
	Brown/Reddish (% cover)		20	10	30		20
Filaments long (>2cm)	Green (% cover)	2	2	30	3		9.25
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA				2		2
Iron Bacteria growths	NA						0

Macrophyte recording sheet											
Stream: Mangapapa Stream			**Located number**:				**Sample Number**: Piako Site 6			**Date**: 15/2/12	
Transect	Wetted width (m)	Channel width (m)	Vegetation cover (% wetted area)								
			Total cover	Submerged plants					Emergent plants		
				Total submerged	Surface-reaching		Below surface		Total emergent	Species
					Sub-total	Species	Sub-total	Species		
1	3.2	3.8	0							
2	3.6	3.8	0							
3	4.1	4.2	0							
4	5.3	5.5	0							
5	4.0	5.0	0							

Periphyton Assessment							
Stream: Waitoa River		Date: 15/2/12					
Sample Number: Piako Site 7		Located number:					
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)	5	7	5	2	10	5.8
	Brown/Reddish (% cover)			5	5		5
Submerged bryophytes	NA						0
Iron Bacteria growths	NA						0

Macrophyte recording sheet										
Stream: Waitoa River			**Located number**:				**Sample Number**: Piako Site 7		**Date**: 15/2/12	
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	3.3	6	25	5			5	Ed	20	Ph
2	3.2	6	14	9			9	Nh 5 Ed 2 Pk 2	5	Ph
3	3.2	4	17	15			15	Nh 10 Pk 5	2	Ph
4	4.3	5	25	15			15	Pk 10 Ed 5	10	Ph 5 Ve 5
5	3.8	4.5	15	10			10	Pk	5	Ph

Periphyton Assessment							
Stream: Waitoa headwaters		Date: 15/2/12					
Sample Number: Piako Site 8		Located number:					
Thickness category	**Colour category**	**A**	**B**	**C**	**D**	**E**	**Mean cover**
Thin (<0.5mm) Mat/Film	NA				10		2
Medium mat/film (0.5-3mm thick)	Green (% cover)	2				5	1.4
	Light brown (% cover)	5				5	2
	Black/dark brown (% cover)						0
Thick (>3mm) mat/film	Green/light brown (% cover)						0
	Black/dark brown (% cover)						0
Filaments short (<2cm)	Green (% cover)		2				0.4
	Brown/Reddish (% cover)						0
Filaments long (>2cm)	Green (% cover)						0
	Brown/Reddish (% cover)						0
Submerged bryophytes	NA		1	1			0.4
Iron Bacteria growths	NA						0

Macrophyte recording sheet											
Stream: Waitoa headwaters			**Located number**:				**Sample Number**: Piako Site 8			**Date**: 16/2/12	
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	1.9	2	0							
2	0.95	1	0							
3	1.9	2.2	0							
4	1.2	1.5	5						5	An
5	1.1	2.0	20						20	An

Periphyton Assessment							
Stream: Waihekau Stream		Date: 16/2/12					
Sample Number: Piako Site 9		Located number:					
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: Waihekau Stream			**Located number**:				**Sample Number**: Piako Site 9		**Date**: 16/2/12		
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	3.3	3.8	80	80			80	Ed		
2	2.9	3.5	60	40			40	Ed	20	Ph
3	3.5	3.8	70	60			60	Ed	10	Ph
4	3.5	4.2	50	25			25	Ed	25	Ph
5	4.0	4.5	20	20			20	Ed		

Periphyton Assessment							
Stream: Waitakaruru Stream tributary		Date: 16/2/12					
Sample Number: Piako Site 10		Located number:					
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: Waitakaruru Stream tributary			**Located number**:				**Sample Number**: Piako Site 10		**Date**: 16/2/12	
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	3.0	0							
2	3.2	3.5	0							
3	3.3	4.0	0							
4	2.45	3.0	10	10			10	Nh	<1	An
5	2.5	2.8	0							