TO:	Winstone Pulp International Limited c/- Babbage Consultants Limited	Date:	29 April 2026
ATTENTION:	Sukhi Singh	Job No:	60337
FROM:	Treffery Barnett, Technical Director - Freshwater Ecology		

RE: Karioi Wood Processing – ecological information

1. Introduction

Winstone Pulp International Limited (WPI) holds an existing discharge permit authorising treated wastewater and stormwater discharges from the former Karioi Pulp Mill (the Site) to the Whangaehu River. The operations on the site ceased in September 2024.

WPI is amending the resource consent application to enable the use of the site for wood processing using a "torrefaction" process (instead of a "pulp" process). Due to the change in the industrial process used for wood processing, it has resulted in:

- Significant reduction in the volume of wastewater produced and sought to be discharged to the Whangaehu River, being 750m^3/day (compared to the approved consented discharge limit of 5,200m^3/day).
- The wastewater produced is classified as a "condensate", and is of a significantly cleaner quality than the wastewater stream approved under the existing consent for the pulp process.

As requested by Ngāti Rangi, WPI proposes to construct a wetland system, to ensure that the wastewater is discharged into the wetland system, prior to the discharge to the Whangaehu River. The wetland will be constructed and designed to provide additional polishing to the treated wastewater prior to discharge to the river.

An Assessment of Environmental Effects Report (hereon referred to as the "Notified AEE") has been prepared by Viridis & Mitchell Daysh (dated March 2025), and includes ecological assessments. When the application was publicly notified, submitters raised concerns regarding effects on aquatic life.

This memorandum presents the results of instream ecological surveys of aquatic life in the Whangaehu River and two adjacent tributaries (for comparison) (Figure 1); provides an assessment of the construction of proposed new wetland system located on the pulp mill site (Figure 2); and assesses the revised application water quality report (Babbage, 2026) in relation to effects on ecology.

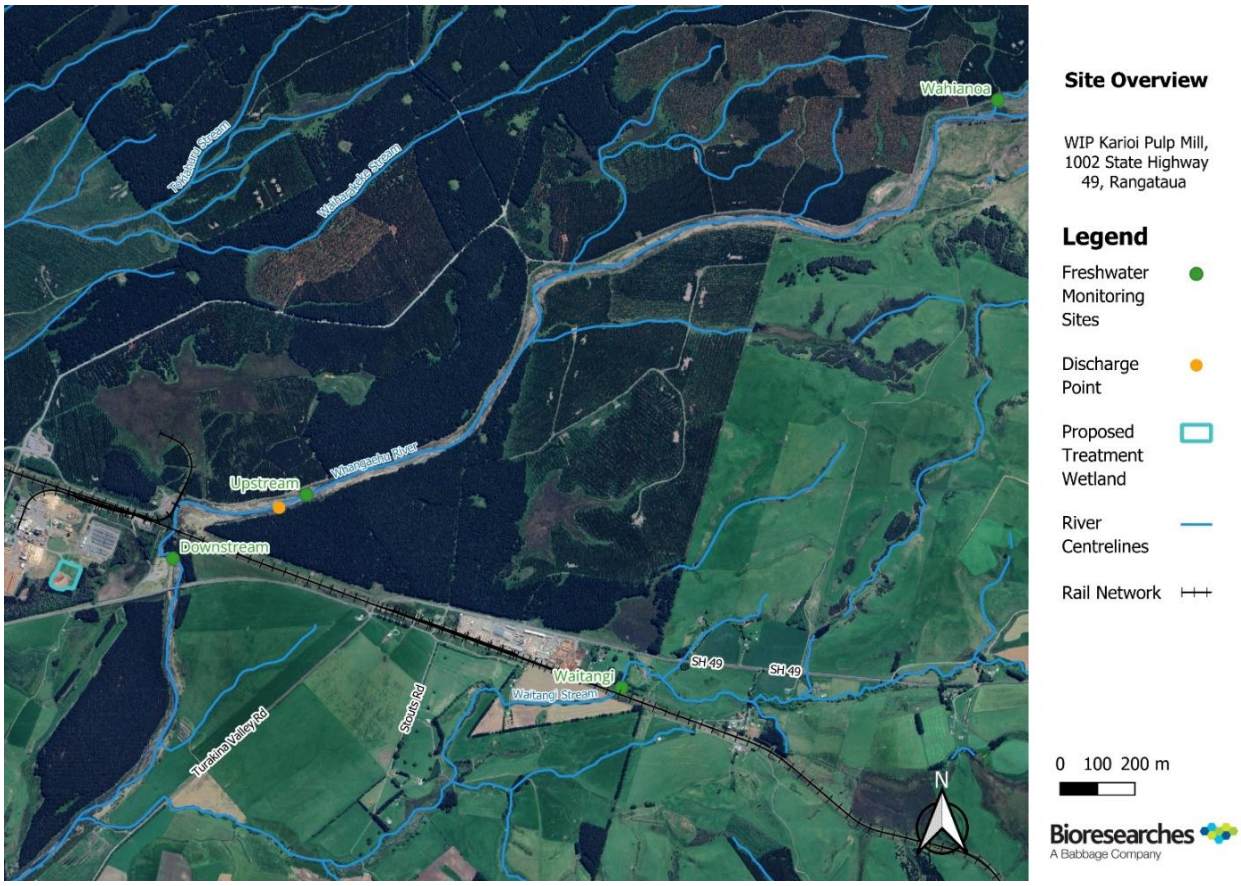

Figure 1. WIP Karioi Pulp Mill instream survey and monitoring sites.

Figure 2. WIP Karioi Pulp Mill Proposed Treatment Wetland.

2. Instream Fauna Assessments – Methodology

2.1 Macroinvertebrates

Macroinvertebrate communities, including the structure, abundance and diversity, are indicators of long-term health of streams and water quality. Different taxa display varying tolerance to pollutants with presence/absence providing indicators to stream health and condition.

Macroinvertebrates were sampled from the upstream and downstream monitoring site habitats in the Whangaehu River, and two tributaries to the Whangaehu River, the Wahianoa and Waitangi Streams (Figure 1) to obtain semi-quantitative data in accordance with the Ministry for the Environment's current 'Protocols for Sampling Macroinvertebrates in Wadeable Streams' (Stark *et al.*, 2001[1]). Sampling was undertaken along 50 m of each reach, using protocol 'C1: hard-bottomed, semi-quantitative' in the Whangaehu River and Wahianoa Stream as they were hard bottomed, and using protocol 'C2: soft-bottomed, semi-quantitative' in the Waitangi Stream as the sampling reach was soft bottomed. The macroinvertebrate samples were preserved in 70% ethyl alcohol (ethanol), returned to the laboratory and sorted (using protocol 'P3: full count with sub-sampling option', Stark *et al.*, 2001). Macroinvertebrates were then identified to the lowest practicable level and counted to enable biotic indices to be calculated.

Five biotic indices were calculated, namely:

- The number of taxa;
- The number and percentage of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) recorded in a sample (%EPT);
- The Macroinvertebrate Community Index (MCI) and;
- The Semi-Quantitative Macroinvertebrate Community Index (SQMCI).

EPT are three orders of insects that are generally sensitive to organic or nutrient enrichment, but the calculation of %EPT specifically excludes Oxyethira and Paroxyethira as these taxa are not sensitive and can proliferate in degraded habitats. The MCI and SQMCI are based on the average sensitivity score of individual taxa recorded, although the SQMCI is calculated using coded abundances instead of actual scores.

For MCI and SQMCI, respectively, scores of:

- ≥120 and ≥ 6.0 are indicative of excellent habitat quality;
- 100 –– 119 and 5.0 – 5.9 are indicative of 9 are indicative of good habitat quality;
- 80 – 99 and 4.0 – 4.9 are indicative of fair habitat quality; and
- < 80 and <4.0 are indicative of poor habitat quality (Stark & Maxted, 2007[2]).

[1] Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R. and Scarsbrook, M. R. (2001). Protocols for sampling macroinvertebrates in wadeable streams, For: the Ministry for the Environment, 57p.

[2] Stark, J. D. and Maxted, J. R. (2007). A user guide for the Macroinvertebrate Community Index. Cawthron Institute for the Ministry for the Environment, 58p.

2.2 Freshwater Fish

Fish communities can be good indicators of stream ecosystem health. The New Zealand Freshwater Fish Database (NZFFDB)[3] provides data on the location and species of freshwater fish throughout New Zealand. A review of the NZFFDB was undertaken to determine the likelihood of freshwater fish species that may be present within the Whangaehu River near the site, from previous and/or historic freshwater fish surveys. (Refer Appendices).

Fish communities were sampled on 4 – 5 March 2026. At each survey location, four fyke nets and eight Gee's minnow traps were set, where sufficient water was present. Nets and traps were baited and left overnight at each site. Nets and traps were set in general accordance with the New Zealand Freshwater Fish Sampling Protocols (Joy et al., 2013)[4], but in modified position or density because of the high velocity of the rivers. Nets were collected the following morning, and the species of each fish was determined, the size of each individual was measured and recorded and general condition noted before being released back into their habitat.

The results of the fish surveys were used to calculate the fish Index of Biotic Integrity (IBI, Table 1.) The fish IBI is calculated for the streams based on fish species present, altitude and distance inland for Horizons Regional Council[5]. The IBI compares the community of fish present, with what might be expected to occur considering altitude and distance inland from the coast (Joy, 2015).

Table 1. Fish IBI scores and classes for Horizons Region (Joy, 2015)

Total IBI score	Integrity class	Attributes
68 -100	Excellent	Comparable to the best situations without human disturbance; all regionally expected species for the stream position are present. Site is above the 80 th percentile of Horizons sites
58 - 67	Good	Site is above the 60 th percentile of all Horizons sites, species richness is slightly less than best for the region
46 - 57	Moderate	Site is above the 40 th percentile of Horizons sites but species richness and habitat or migratory access reduced, some signs of stress.
36 - 45	Poor	Site is less than average for Horizons region IBI scores, less than the 40 th percentile, thus species richness and or habitat are severely impacted
1 - 35	Very poor	Site is below the 20th percentile meaning site is impacted or migratory access almost non existent
0	No native fish	Site is grossly impacted or access non existent

In situ Water Quality Measurements

In addition to the fauna surveys, to inform the results, spot water quality measurements were taken by WIP staff at the time of the fauna surveys. Temperature (°C), dissolved oxygen (% and mg/L), conductivity (µS/cm), and pH were collected, using a hand-held water quality meter.

[3]NIWA (accessed April 2026). https://nzffdms.niwa.co.nz/

[4] Joy, M.; David, B; Lake, M. (2013) New Zealand freshwater fish sampling protocols: part 1—wadeable rivers and streams. Massey University, Palmerston North.

[5] Joy, Mike (2015). A Fish Index of Biotic Integrity (IBI) For Horizons Regional Council. Report prepared by Ecology group Massey University Palmerston North. June 2015. 22pp. Horizons Report 2015/EXT/1463. Envirolink Report 1541-HZLC118.

3. Whangaehu River, Waitangi and Wahianoa Streams Instream Fauna

The spot water quality measurements and instream fauna data are summarised as Table 2, with the raw macroinvertebrate and fish data presented in the appendices.

The Whangaehu River was a swiftly flowing, cobble and boulder river with sandy and boulder flood plain and banks. Although there were no pools present, the hydrological variation was high with riffle run sequences, rapids and eddies around boulders. At the time of the site visit the river water was milky in colour with suspended material. The riparian vegetation was depauperate, comprised of small dominantly exotic shrubs. Although the riparian vegetation transitioned to pine plantation, it provided no or minimal shading to the river. (Photo 1 and Photo 2)

Photo 1. Whangaehu River – upstream site.

Photo 2. Whangaehu River downstream site.

The Wahianoa Stream is a side tributary to the Whangaehu River, with its confluence approximately 4.5 km upstream of the WPI Site. The Wahianoa Stream was cobble and boulder based, and swift flowing with dense shrubby riparian vegetation, dominated by pampas, before transitioning to pine plantation. The sampling site was upstream and downstream of the ford as access was limited by thick pampas.

Photo 3. Wahianoa Stream upstream of ford, deep pool and cobble substrate.

Photo 4. Wahianoa Stream, downstream of ford, swift flowing over boulder and cobble substrate.

The Waitangi Stream sampling reach formed a uniform run between incised banks. The riparian vegetation was comprised of dense, long pasture grasses and pasture weeds, with occasional shrubs. The substrate dominated by soft substrates, with occasional cobbles and occasional dense patches of macrophytes.

Photo 5. Waitangi Stream.

Photo 6. Waitangi Stream downstream in sampling reach.

Although the macroinvertebrate number and diversity of taxa in the Whangaehu River was very low, the Whangaehu River macroinvertebrates were mostly very high scoring EPT taxa, resulting in 'Excellent' MCI and SQMCI scores (Table 2).

Macroinvertebrates in the two tributaries to the Whangaehu River both had a higher diversity of taxa (more than double) and much higher abundance of individuals. The MCI at the Wahianoa Stream, was indicative of 'Good' quality habitat and in the Waitangi Stream, indicative of 'Fair' quality habitat (albeit, right on the boundary between Fair and Good). The SQMCI scores, which take into account the relative abundance of the taxa (as well as their scores), reflected the dominance by higher scoring Elminidae beetle larvae in the Wahianoa Stream and dominance of much lower scoring sandfly larvae in the Waitangi Stream.

The spot measurements of water quality in the Whangaehu River showed the pH to be acidic, pH 3.2, and high conductivity, 1676-1732 µs/cm. These water quality parameters result in macroinvertebrate communities that are depauperate, less diverse, with many taxa disappearing entirely as the pH drops, and usually the first taxa to be lost are the more sensitive EPT taxa. These macroinvertebrate results for the Whangaehu River are therefore unexpected, and it is likely that the more sensitive mature taxa (such as Plectoptera) would have arrived at the site through drift from an upstream tributary or possibly developed in a microrefuge such as a groundwater seep.

No fish were caught in the nets and traps in the Whangaehu River, and only two juvenile rainbow trout (*Oncorhynchus mykiss*) in each of the side streams. Records from the NZFFDB over 30 km of the Whangaehu River, 15 km each side of the site, showed no native fish (12 records), with one record of a single rainbow trout, well downstream (Appendix 2).

Table 2. Summary data from Stream Surveys 4 – 5 March 2026

Site	Upstream	Downstream	Wahianoa	Waitangi
Date	4/03/2026	4/03/2026	4/03/2026	4/03/2026
Water Quality				
Time (NZDT)	13:41	18:10	15:07	16:34
Temperature(°C)	10.2	15.4	13.8	11.3
Pressure (mmHG)	707.8	707.9	703.4	707.4

DO%	88.1	76.8	88.8	97.7
DO (mg/L)	9.64	7.58	9.18	10.67
Conductivity (µs/cm)	1732	1676	138	1823
pH	3.24	3.22	7.83	7.9
Macroinvertebrates				
No. of taxa	6	5	15	27
No. of individuals	7	6	234	2868
Dominant taxa	No dominants	No dominants	Elminidae	*Austrosimulium*
No. of ETP taxa	3	4	7	12
MCI	123 'Excellent'	136 'Excellent'	112 'Good'	99 'Fair'
SQMCI	6.17 'Excellent'	6.80 'Excellent'	6.19 'Excellent'	4.43 'Fair'
% EPT	43	83	35	15
Native Fish				
Fish IBI score	0	0	0	0
	No native fish	No native fish	No native fish	No native fish
Exotic Fish				
	Nil	Nil	Rainbow trout	Rainbow trout

Constructed Wetland

The wetland is situated within a predominantly flat, landscaped and maintained area of the WPI site. The site of the proposed wetland includes a large constructed pond. Existing vegetation surrounding the constructed pond is dominantly mown grass, bounded by a mix of native and exotic shrubs and pines (Photo 7 and Photo 8).

Photo 7. Current pond view south towards the main road.

Photo 8. Paddock north of pond, view towards the pulp mill.

The proposed earth worked area for the pond is approximated 17,150 m^2 and will result in the construction of four separate basins. The construction works are works are subject to an Erosion

and Sediment Control Plan (Cheal, 2026)[6], to ensure that adverse effects during construction on the land and water resources are remediated and mitigated.

No natural inland wetlands were observed on the site, or in the immediate vicinity of the proposed works area.

When assessing the ecological effects of the proposed treatment wetland works, it is current best practice to use the EIANZ Ecological Impact Assessment Guidelines (Roper-Lindsay et al., 2018[7]), which provide a structured framework for evaluating ecological value, assessing the magnitude of potential effects, and determining the overall level of effect (Appendix 3). The EIANZ methodology enables ecological effects to be expressed transparently and consistently, facilitating informed decision-making and alignment with national best practice for ecological assessment in New Zealand.

In accordance with the EIANZ guideline, the ecological value of vegetation at the proposed treatment wetland site is assessed as **Negligible**. The loss of the vegetation is assessed as a **High** magnitude of effect, resulting in an overall **Very Low** level of effect.

Figure 3. Constructed Wetland (Cheal, 2026)

[6] Cheal (2026) 1002 State Highway 49, Tangiwai, Ohakune Wetland Construction - Erosion and Sediment Control Plan. Report for Babbage Consultants Limited. 11pp. 9 April 2026.

[7] Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

As part of the ecological assessments, the Water Quality Assessment Memo (Babbage, 2026[8]) was reviewed in the context of ecological effects.

The Revised Application shows a significant (85%) reduction in volume of discharge compared to the former consented discharge, and with the use of the robust wetland system to polish and discharge wastewater to the Whangaehu River, an improvement in quality of the discharge, compared to both the former consented discharge and the Notified Application.

The Whangaehu River exhibits unique water quality conditions influenced by volcanic inputs from Mt Ruapehu, resulting in naturally very low pH (acidic water) and high phosphorus concentrations. The consistently naturally very low pH is an ecologically limiting factor in the river, resulting in a naturally very low macroinvertebrate abundance and diversity and no native fish. Review of the parameters assessed within the Water Quality Assessment Memo demonstrate that the introduction of the treated discharge, representing less than 3% of the 7-day MALF flow, is highly unlikely to result in adverse effects on the river's ecology, with several aspects of the proposal providing positive outcomes when compared to the former WPI discharge. When the ecological effects of the Revised Application discharge are assessed using the EIANZ guidelines, the ecological fauna values of the Whangaehu River are **low**, the magnitude of the effect of the discharge will be **negligible** (very slight change from the existing baseline condition), resulting in a **Very low** level of ecological effect.

Kind regards,

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Bioresearches
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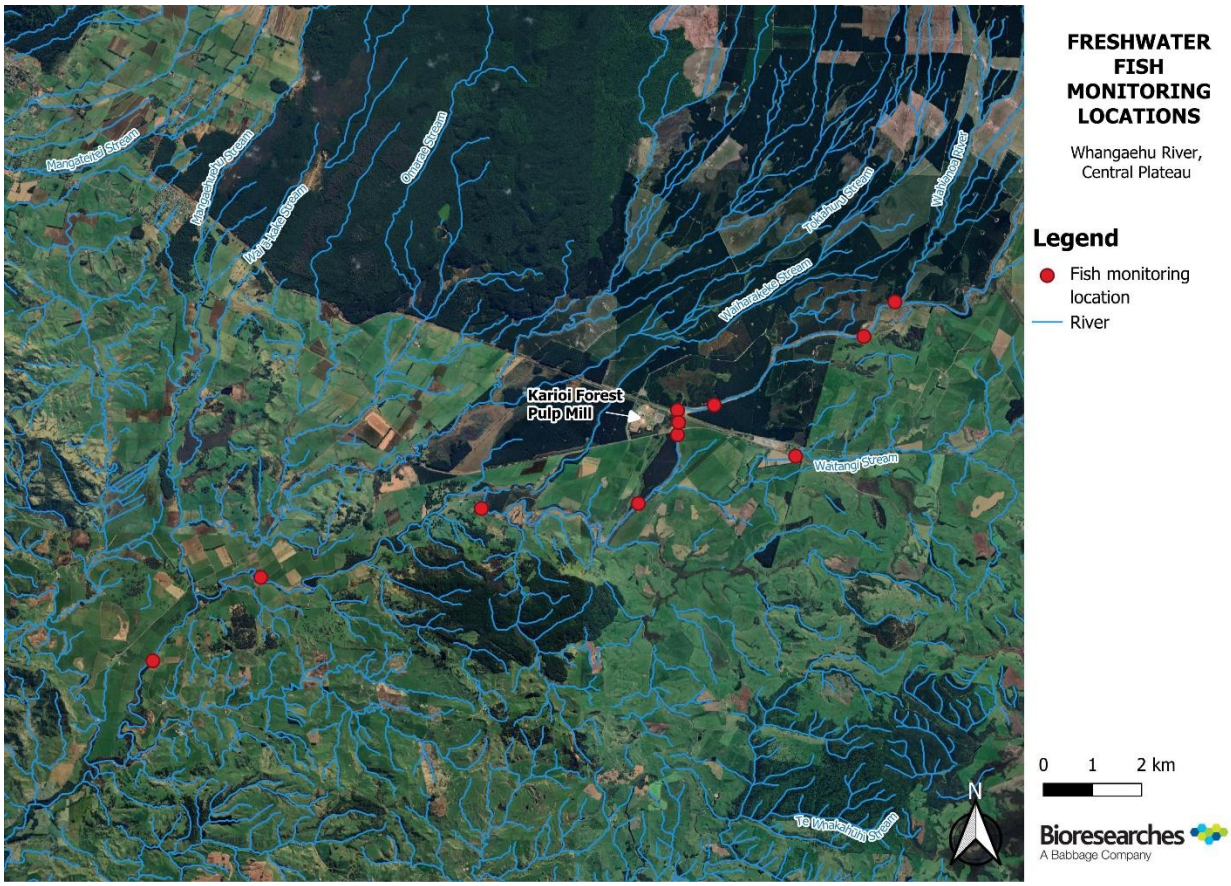
[8] Babbage Consultants Limited (2026) Water Quality Assessment Memo. Memorandum to Winstone Pulp International Limited. 21 April 2026. 17pp.

Appendix 1 Raw Macroinvertebrate Data

						HB	HB	HB	SB
PHYLUM	**CLASS: Order**	**Family**	**Taxa**	**Taxa MCI hb**	**Taxa MCI sb**	**Whangaehu U/S**	**Whangaehu D/S**	**Wahianoa**	**Waitangi**
ANNELIDA	**OLIGOCHAETA**		Oligochaeta	1	3.8				8
MOLLUSCA	**GASTROPODA**	Hydrobiidae	*Potamopyrgus antipodarum*	4	2.1			1	32
		Physidae	*Physella fontinalis*	3	0.1				12
	BIVALVIA		*Sphaerium novaezelandiae*	3	2.9				1
ARTHROPODA	**CRUSTACEA: Ostracoda**		*Herpetocypris pascheri*	3	1.9				4
	Decapoda		*Paranephrops planifrons*	5	8.4				1
	INSECTA: Ephemeroptera	Siphlonuridae	*Oniscigaster distans*	10	5.1			11	
		Leptophlebiidae	*Deleatidium* spp	8	5.6			41	
			Austroclima sepia	9	6.5				68
			Zephlebia spp	7	8.8	1	1		88
	Plecoptera	Gripopterygidae	*Megaleptoperla grandis*	9	7.3			9	16
			Zelandoperla sp.	10	8.9	1	1		
			Acroperla trivacuata	5	5.1				12
	Trichoptera		*Aoteapsyche colonica*	4	6			9	120
		Hydroptilidae	*Oxyethira albiceps*	2	1.2				20
		Hydrobiosidae	*Hydrobiosis parumbripennis*	5	6.7			10	36
			H. clavigera	5	6.7			1	
			Psilochorema sp.	8	7.8				8
			Neurochorema confusum	6	6				1
			Costachorema sp.	7	7.2	1			2
			Edpercivalia maxima	9	6.3		2		3
		Leptoceridae	*Triplectides obsoleta*	5	5.7		1		68
		Conoesucidae	*Pycnocentria evecta*	7	6.8			1	
	Coleoptera	Elmidae	Elmidae	6	7.2	2		112	
		Scirtidae	Scirtidae	8	6.4				4
	Lepidoptera		*Hygraula nitens*	4	1.3				4
	Diptera	Tipulidae	*Aphrophilia neozelandica*	5	5.6			6	
		Hexatomini	Eriopterini	9	7.5			8	
		Simuliidae	*Austrosimulium australense* gp	3	3.9		1	15	2220
		Chironomidae	*Maoridiamesa* sp.	3	4.9			7	80
			Lobodiamesa sp.	5	7.7				16
			Tanytarsini	3	4.5				4
			Tanytarsus sp.	3	3.8			1	
			Orthcladiinae	2	3.2				20
			Corynoneura sp.	2	1.7				4
			Tanypodinae	5	6.5				16
		Muscidae	*Limnophora* sp.	3	4.5	1		2	
		Dixidae	*Nothodixa* sp.	4	9.3	1			
		TOTALS:	**NO. TAXA**			6	5	15	27
			NO. EPT TAXA			3	4	7	12
			NO. INDIVIDUALS			7	6	234	2868
			MCI			123	136	112	99
						Excellent	Excellent	Good	Fair
			SQMCI			6.17	6.80	6.19	4.43
						Excellent	Excellent	Excellent	Fair
			%EPT			42.9	83.3	35.0	14.7

Appendix 2. Current records and New Zealand Freshwater Fish Database Records for the Whangaehu within approximately 15 km radius of the Site

Site		nzffd record #	Species found	Native species richness	Total species	% native fish	IBI score	Ecological class
Wahianoa River	US 1		No species recorded	0	0	0	0	No native fish
Wahianoa River	US 2		No species recorded	0	0	0	0	No native fish
Wahianoa River			No species recorded	0	0	0	0	No native fish
Waitangi Stream			No species recorded	0	0	0	0	No native fish
Whangaehu River		8002	No species recorded	0	0	0	0	No native fish
Whangaehu River		8003	No species recorded	0	0	0	0	No native fish
Whangaehu River		8004	No species recorded	0	0	0	0	No native fish
Whangaehu River		8006	No species recorded	0	0	0	0	No native fish
Whangaehu River		8007	No species recorded	0	0	0	0	No native fish
Whangaehu River		8008	No species recorded	0	0	0	0	No native fish
Whangaehu River		8011	No species recorded	0	0	0	0	No native fish
Whangaehu River tributary		17681	No species recorded	0	0	0	0	No native fish
Whangaehu River tributary		17682	Rainbow trout	0	1	0	0	No native fish
Whangaehu River tributary		17683	No species recorded	0	0	0	0	No native fish
Whangaehu River tributary		17684	No species recorded	0	0	0	0	No native fish
Whangaehu River tributary		30441	No species recorded	0	0	0	0	No native fish
Whangaehu River tributary		30442	Rainbow trout	0	1	0	0	No native fish



Appendix 3. Criteria for Describing Level of Ecological Effects (from Table 10 of the EIANZ guidelines for Ecological Impact Assessment, Roper-Lindsay et al, 2018)

Magnitude of Effect	Ecological Value				
	Very High	High	Moderate	Low	Negligible
Very High	***Very High***	***Very High***	***High***	***Moderate***	**Low**
High	***Very High***	***Very High***	***Moderate***	Low	Very Low
Moderate	***High***	***High***	***Moderate***	Low	Very Low
Low	***Moderate***	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain