Supplementary Ecological Impact Assessment

McCulloughs Creek Hydro Scheme
Prepared for No.8 Ltd
4 April 2019

ECOLOGY NEW ZEALAND

Report Number 1708124.4 V2

Document Sign Off

Author(s):	Marc Choromanski Senior Ecologist Ecology New Zealand Limited	
	Connor Whitley Senior Ecologist Ecology New Zealand Limited	
Review:	Chad Croft Principal Ecologist Ecology New Zealand Limited	
Approved for Release:	Chad Croft Principal Ecologist Ecology New Zealand Limited	

Contents

1. Introduction 6
   1.1. Purpose and Scope 6
   1.2. EIANZ Assessment Methodology 6
      1.2.1. Values Assessment 6
      1.2.2. Magnitude of Effects Assessment 7
      1.2.3. Overall Level of Effects Assessment 7
2. Chiropterofauna 7
   2.1. Introduction 7
   2.2. Methods 7
   2.3. Results 8
   2.4. Discussion 11
3. Avifauna 12
   3.1. Introduction 12
   3.2. Methods 12
   3.3. Results 12
   3.4. Discussion 15
4. Herpetofauna 16
   4.1. Introduction 16
   4.2. Methods 16
   4.3. Results 17
   4.4. Discussion 17
5. Fish 19
   5.1. Introduction 19
   5.2. Methods 19
   5.3. Results 19
      5.3.1. Fishing Survey 19
      5.3.2. 1D Model 21
   5.4. Discussion 24
6. Aquatic Macroinvertebrates 25
   6.1. Introduction 25
   6.2. Methods 25
   6.3. Results 25
   6.4. Discussion 27
7. Ecological Impact Assessment 28
   7.1. Westland District Plan 28

7.2. Terrestrial Ecology 30
7.2.1. EIANZ Values Assessment 30
7.2.2. EIANZ Magnitude of Effects Assessment 33
7.2.3. EIANZ Overall Level of Unmitigated Effects 34
7.3. Freshwater Ecology 35
7.3.1. EIANZ Values Assessment 35
7.3.2. EIANZ Magnitude of Effects Assessment 36
7.3.3. EIANZ Overall Level of Unmitigated Effects 40
8. Management of Effects Reccomendations 41
8.1. Terrestrial Ecology 41
8.2. Freshwater Ecology 42
9. Residual Effects Assessment 42
10. Conclusion 42

List of Figures

Figure 1: Summary of all indicative long-tailed bat passes obtained from bioacoustic survey 10

Figure 1 Estimated AWS per species as the flow rates change across the average assessed reach 23

Figure 3 Shows Cross Section habitat suitability analysis of all species at Cross Section 10 and koaro at Cross Section 1 and compares the current predicted habitat suitability against the reduce flow predicted habitat suitability 39

List of Tables

Table 1: Summary of long-tailed bat activity across survey area 9

Table 2: Avifauna species documented during field investigations 13

Table 3: Diversity of native avifauna with a conservation status higher than Not Threatened and, considered potentially within the Project area as described within the ENZL supplementary ecology report. 14

Table 4 Summary of all fish caught within the February 2019 field surveys. 20

Table 5: Seasonal averages of recorded flow rates and predicted seasonal flow (circa 0.6 m3/s abstraction) associated with the proposed Hydro Scheme 21

Table 6 Site description of all sample sites and the associated MCI Scores. 25

Table 7 Summary of all macroinvertebrates caught within the February 2019 field surveys condensed from Table 12. Conservation status derived from Conservation status of New Zealand freshwater invertebrates, 2018. 27

Table 8 Ecological significance assessment following criteria as detailed within Section 4.9 - Policy D, of the Westland District Plan 28

Table 9 Ecological values assessment as per Table 4 of the EcIA EIANZ guidelines, 2018 31

Table 10 Overall terrestrial values assessment for the site 33

Table 11 Summary of expected magnitude of effects on terrestrial ecosystems 34

Table 12 Summary of overall level of unmitigated effects 34

Table 13 Ecological values assessment as per Table 4 of the EcIA EIANZ guidelines, 2018 35

Table 14 Overall freshwater values assessment for the site 36

Table 15 Current AWS values and predicted AWS values based estimated average flows for all species occurring within the impact reach. Note values derived from Figure 1 37

Table 16 Summary of expected magnitude of effects 40

Table 17 Summary of overall level of unmitigated effects of Freshwater Ecosystems 40

Table 18 Results of Fishing effort detailing methodology of capture, amount caught and size distribution. Note UB = Un-baited trap, B = Baited trap. 51

Table 19 Cross section benthic substrate compositional break down 52

Table 20 Cross section water column habitat analysis percentage distribution. 52

Table 21 Cross section analysis of the reaches Area Weighted Suitability (AWS) and Calculated Habitat Suitability (CSI). 53

Table 22 break down of all macroinvertebrates caught within the February 2019 field surveys. 54

Appendix

APPENDIX A Report Limitations 45

APPENDIX B Terrestrial Field Investigation Effort 46

APPENDIX C Fish Survey Effort 48

APPENDIX D Aquatic Features and Location of Cross Sections for 1D Modelling 50

APPENDIX E Freshwater Output Tables 52

APPENDIX F Tree Removal Protocol 57

1. INTRODUCTION

1.1. Purpose and Scope

This report[1], prepared by Ecology New Zealand Limited (ENZL) for No. 8 Limited ('the client)', presents the results of supplementary ecological investigations undertaken as part of the proposed McCulloughs Creek Hydro Scheme ('the Project') located in Whataroa, Westland. This scope has been guided by a request for further information and expert commentary provided by the Department of Conservation (DOC).

The preparation of this report is intended to support, validate and where applicable, amend the desktop based Supplementary Ecology Report undertaken by ENZL[2] and the preliminary Assessment of Ecological Effects Report prepared by Wildland Consultants Limited (Wildlands)[3]. It is intended for this report to be an extension of ENZLs prior assessment and is read in conjunction with the Wildlands ecological assessment.

1.2. EIANZ Assessment Methodology

The assessment of effects on both terrestrial and aquatic fauna values will be undertaken against the second edition (May 2018) Ecological Impact Assessment (EcIA) guidelines as detailed by the Environment Institute of Australia and New Zealand (EIANZ)[4]. The guidelines provide a transparent stepwise approach to evaluate a projects level of ecological effect, providing insight into feasibility and the management of effects through avoidance, mitigation and biodiversity offsetting. These guidelines have been adopted to allow for expert judgement and the consideration of implications under New Zealand's Wildlife Act 1953.

1.2.1. Values Assessment

Four criteria are used to determine the ecological value of the site's ecological features; these being 'Representativeness, Rarity/distinctiveness, Diversity and Pattern, and Ecological Context'. To assign value under each of these four criteria, an explanation on each criterion and a series of attributes are provided for consideration in Table 4 of the EIANZ guidelines. A scoring system provided in Table 6 of the guidelines requires the combination of these assessment values to provide an overall assignment of ecological value.

[1] This report is subject to the Report Limitations provided in Attachment A.
[2] Choromanski, M. Whiteley, C. 2018. McCulloughs Creek Hydropower Scheme Supplementary Ecology Report 1708124 prepared for No.8 Limited. Ecology New Zealand Ltd.
[3] Hutchinson, M. McCaughan, H and Patrick, B., 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205. Wildlands Consultants
[4] Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2nd ed.). Melbourne: EIANZ.

1.2.2. Magnitude of Effects Assessment

An assessment of the projects magnitude of effects is evaluated with the consideration of impacts on identified ecological values. Impacts are considered in the context of the project footprint (i.e the actual area where infrastructure, vegetation clearance, water take and water return will occur). Impacts are considered against several factors including:

- The scale of impacts (i.e. the real extent of the Project footprint);
- The extent or proportion of habitat loss versus local availability (e.g. the proportion of habitat loss relative to the contiguous habitat that remains);
- The duration of impacts (e.g. permanent versus temporary); and
- The intensity of the unmitigated effect (i.e. the extent to which habitat loss within the Project footprint was complete or partial).

1.2.3. Overall Level of Effects Assessment

An overall level of effects assessment is undertaken using a matrix which, weights the assessed ecological values against the magnitude of effects. This overall level of effect is determined in lieu of any avoidance, mitigation or offsetting measures being implemented. This assessment framework allows for effects to be ranked on a gradient from 'Negligible' to 'Very High' and provides justification for avoidance, mitigation and offsetting requirements as appropriate.

2. CHIROPTEROFAUNA

2.1. Introduction

The Supplementary Ecology Report prepared by ENZL identified a low likelihood of short-tailed bat (*Mystacina tuberculata tuberculata*) presence and a high likelihood of long-tailed bat (*Chalinolobus tuberculatus*) presence across the site. To validate bat presence, ENZL undertook a bioacoustic surveys across the site for both of these species. In addition to these surveys, a high-level habitat assessment was undertaken across the site to determine the quality of potential roosting and foraging habitat where it was present.

2.2. Methods

A total of six AR4 model automatic bat monitors (ABM) were deployed across the survey site (Appendix B). These ABMs are the most recent generation produced by DOC and are currently the best industry standard tool for native bat monitoring. ABMs were strategically positioned in potential commuting and foraging areas in direct vicinity to high quality roosting areas. Two ABMs were positioned on areas of interior forest edge to target both short and long-tailed bats. Key areas identified included edges of contiguous mature forest (both forest interior and exterior) and along watercourses (Appendix B). All ABMs were installed by a Level B bat ecologist under the direct supervision of a Level D bat ecologist, as recognised under DOCs bat competency framework.

ABMs were set to initiate recording one hour prior to official local sunset and record until one hour after official local sunrise. ABMs were set between three to five metres high on a tree

which contained as little branch foliage as possible (to reduce recording distortion). These were installed in the field across 12 and 13 of February 2019 and retrieved on 26 February 2019.

All raw data obtained from ABMs were processed on *BatSearch* 3.11 software to obtain presence and absence information across each monitoring station. A recent software update on four of six ABMs additionally provided infield temperature data during the survey period which was obtained from in-built temperature loggers.

In an attempt to detect potential bat presence in real time, two ecologists equipped with hand-held bat detectors (Magenta Bat 4 Bat Detector) undertook walking surveys over two nights. Surveys were undertaken during suitable weather conditions for bats (no rain occurrence from sunset, temperatures above 10° C, no strong winds). These passive surveys were undertaken during nocturnal spotlighting for herpetofauna and comprised of approximately 7 hours of survey effort (APPENDIX B). One hand-held detector was set to monitor at 27hz to target short-tailed bats, with the other set to 40hz targeting long-tailed bats.

2.3. Results

The site provided suitable roosting and foraging habitat for both long-tailed and short-tailed bats. The mature forest setting provided ample mature specimen trees bearing suitable roosting features for both bat species including cracks, crevices, large epiphyte loads, and hollows. Notable specimen trees were scattered in the forested area, including a noted rimu (*Dacrydium cupressinum*), with a diameter at breast height in excess of 1.5m. Large areas of forest interior contained dense thickets of supplejack (*Ripogonum scandens*) which would expectantly act to hinder flying abilities across lower tiers of the forest.

No long-tailed bats or short-tailed bats were detected during the hand-held bat detector surveys undertaken on the 12th and 14th of February 2019.

The results of the bioacoustic ABM surveys undertaken during February 2019 confirmed the presence of only long-tailed bats across the surveyed project area; validating previous desktop assessments. Indicative passes of long-tailed bats were documented across four of six ABMs, with the highest number of passes identified at ABM3 (Table 1) and the strongest passes at ABM 1 and 3 (Figure 1). The level of bat activity detected during the survey period was considered very low, with all ABMs showing a mean number of bat passes per valid night of less than one (Table 1).

With a total of three bat passes, ABM 3 displayed the highest level of bat activity (Table 1). This ABM was positioned on a forest and pasture interface; located approximately 250m from the Whataroa Highway (Appendix B). No passes were detected at ABM 2 located on Parkers Creek or at ABM 4 located at the southern end of the forest interior pastural area (Appendix B).

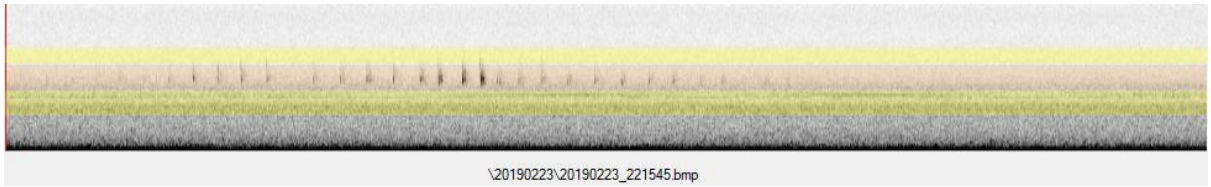
No feeding buzzes were detected during the survey period.

Table 1: Summary of long-tailed bat activity across survey area as detected by ABM

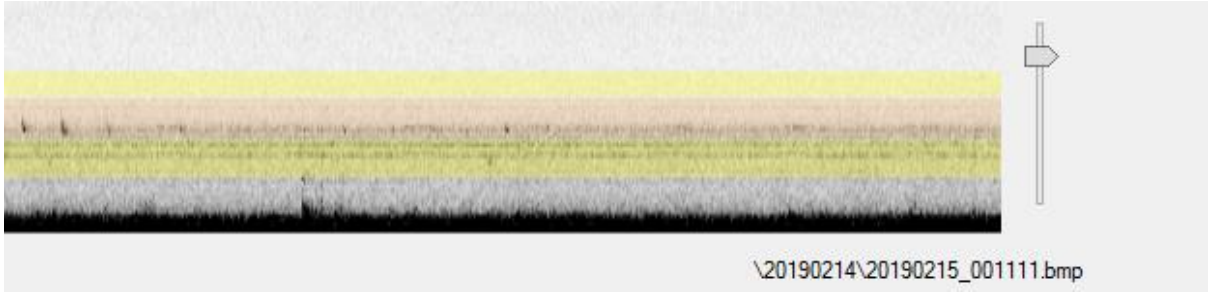
Survey Site	Number of Valid Survey Nights[5]	Number of Valid Survey Nights with Bats	Total Passes Recorded	Mean Number of Passes Per Valid Night
ABM 1	14	1	1	**0.07**
ABM 2	13	0	0	**0.00**
ABM 3	14	3	3	**0.21**
ABM 4*	7	0	0	**0.00**
ABM 5	14	1	1	**0.07**
ABM 6	13	1	1	**0.08**

*ABM 4 was found on the ground on retrieval. It is expected that this fell during a storm event on 21 February 2019.

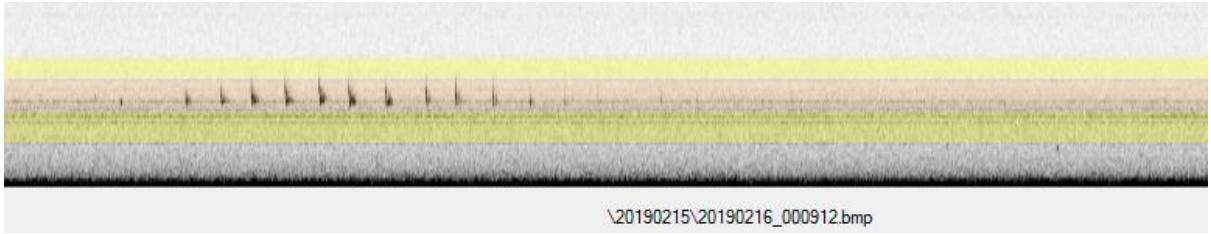
[5] Valid survey night – Nightly temperatures above 10° C, no rain within the first two hours after sunset or bats detected on that night.



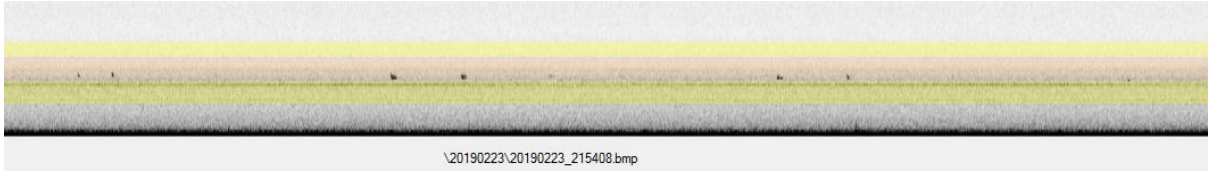
ABM 1: 22:15pm, 23/02/2019



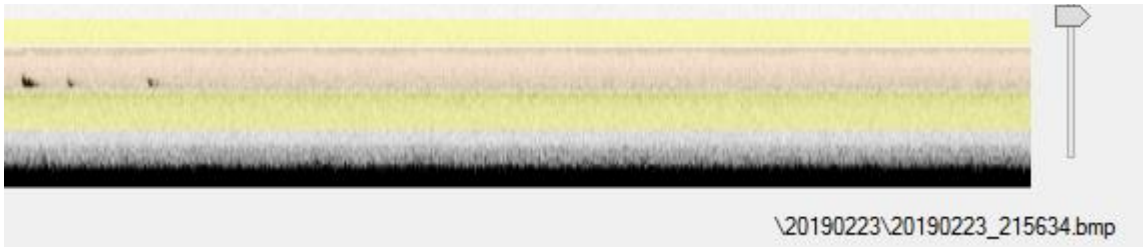
ABM 3: 00:11, 15/02/19



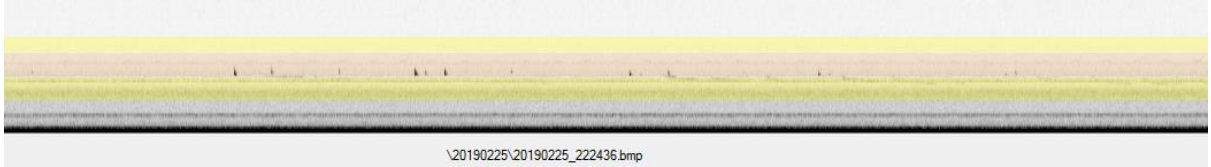
ABM 3: 00:09, 16/02/2019



ABM 3: 22:54, 23/02/2019



ABM 5: 21:56, 23/02/2019



ABM 6: 22:24, 25/02/19

Figure 1: Summary of all indicative long-tailed bat passes obtained from bioacoustic survey

2.4. Discussion

Historical records of long-tailed bats obtained from DOC, detail observations 17km (2000) and 20 km (1985) north-east of the site and 39km (1989) south-west of the site; highlighting an approximately 56km gap between these known observations[6]. This gap is now able to be filled with the results of this study. Though activity levels were deemed very low during the survey period, this is a notable discovery by the project, which identified that at the least, this species is commuting across the western foothills of Mt Adams.

Bats are able to fly at 60km/h and have been documented flying 36km to foraging grounds and occupying home ranges up to 100km[2,7]. Though this species displays use of large home ranges, roosting generally occurs in core areas, with individual colonies generally showing very little geographical overlap during the breeding season (as observed in Eglington Valley). Given the seasonal timing of the bioacoustic survey (February), local maternity roosts are expected to still be active. These roosts would be occupied by mature females and newly volant juveniles which would start becoming more independent during early Autumn when early mating is predicted[8]. With the above considered, the results of bioacoustic surveys demonstrate very low activity levels and the timing of bat passes are not indicative of local roosting (i.e. no peaks in sunrise and sunset activity). It is therefore likely that the detected bat(s) are commuting across the survey site from their core roosting and feeding areas where activity levels would be expected to be much higher. Trapping and tracking would be required to establish these key roosting and feeding areas; however, current activity levels do not make this site conducive to successfully undertake such a programme.

Survey efforts for bats were restricted to the southern portion of the project areas due to access constraints. However, if long-tailed bats were roosting at higher altitudes, it is anticipated that bat passes at the southern survey site would be substantially higher. This is expected as the McCulloughs Creek valley is a key topographical feature in the local landscape and commuting bats are expected to descend along the valley slopes to lower altitude foraging areas.

A marked change in bat echolocation can be used to identify bat foraging activity. These changes are characterised by 'search phase' echolocation calls which transition to a rapid 'approach phase' echolocation and ultimately a 'feeding buzz'. The frequency of feeding buzzes at a given site, is able to be interpolated to provide insight into the significance of that site for bat foraging during a given survey period. No feeding buzzes were detected, therefore the importance of the survey area for feeding is classified as low for the survey period.

Although short-tailed bats were not detected during the survey period, their presence cannot be fully discounted. This species is known to be rare across the South Island[9,10] with the only known extant mainland populations in the Eglington Valley and the Murchison Mountains. It is considered unlikely that this species is present across the survey site.

---

[6] Department of Conservation National Bat Database, 2018.
[7] O'Donnell, C. F. (2001). Home range and use of space by Chalinolobus tuberculatus, a temperate rainforest bat from New Zealand. *Journal of Zoology*, *253*(2), 253-264.
[8] O'Donnell, C. F. (2002). Timing of breeding, productivity and survival of long-tailed bats Chalinolobus tuberculatus (Chiroptera: Vespertilionidae) in cold-temperate rainforest in New Zealand. *Journal of Zoology*, *257*(3), 311-323.
[9] Lloyd, B. D. 2005. Lesser short-tailed bat. '*The handbook of New Zealand mammals*'. C. King. Melbourne, Oxford University Press: 110-126.
[10] Lloyd, B.D. 2009. Acoustic survey of the Oparara Basin for lesser short-tailed bats *Mystacina tuberculata*: October 2009. Lloyds Ecological Consulting.

3. AVIFAUNA

3.1. Introduction

The Supplementary Ecology Report prepared by ENZL identified 14 'Threatened' and 'At Risk' bird species known to inhabit the wider local landscape and provided assessment on the likelihood of their presence within the project areas. To validate this assessment, targeted five-minute bird counts (5MBC)[11] and nocturnal bioacoustic surveys were undertaken by ENZL. In addition, all bird species encountered during the undertaking of wider ecological surveys were documented.

3.2. Methods

A total of four, five-minute bird counts were undertaken by two ecologists over the 11th – 14th of February 2019. This method entailed both observers recording all species of birds seen and heard at a determined monitoring station over a five-minute period. These surveys were conducted across representative habitat types within the vicinity of the proposed Hydro Scheme and included forest interior, pasture/forest edge, and riparian habitat.

All bird species encountered during the undertaking of wider ecological field studies between 11th to 26th February 2019 were documented. This included documentation during both diurnal and nocturnal field works; which increased the likelihood of encounter with a higher number of species.

To further target nocturnal bird species, two AR4 model bioacoustic recorders were installed in the field across 12 and 13 of February 2019 and retrieved on 26 February 2019. These monitors were set to record one hour prior to official local sunset until one hour after official local sunrise. The monitors were set to record at the 'Low' frequency for nocturnally active species such as kiwi (*Apteryx sp.*), weka (*Gallirallus australis*), morepork (*Ninox novaeseelandiae novaeseelandiae*), long-tailed cuckoo (*Eudynamys taitensis*), and semi nocturnal kea (*Nestor notabilis*) and kaka (*Nestor meridionalis meridionalis*). All acoustic recordings were processed through *Kaleidoscope* software to determine species presence.

3.3. Results

The site provided suitable habitat for a diverse range of bird species. Key habitat types included mature forest area (being the majority of the proposed pipeline route), a fast-flowing forested watercourse being McCulloughs Creek, and areas of pastural grassland located at the eastern foothills of the site. In addition, a notable area of pastural grassland was observed in an area of forest interior south of the proposed Hydro Scheme project area.

A total of 18 bird species were documented during February 2019 survey efforts (Table 2). These species comprised 15 native species and two introduced and naturalised species. Key species

[11] Dawson DG, Bull PC 1975. Counting birds in New Zealand forests. Notornis 22: 101–109

of conservation concern included kea (Threatened, Nationally Endangered), New Zealand falcon (At Risk, Recovering) and South Island fernbird (At Risk, Declining)[12].

Table 2: Avifauna species documented during field investigations

Common Name	Scientific Name	Conservation Status
Bellbird	*Anthornis melanura melanura*	Not Threatened
Brown Creeper	*Mohoua novaeseelandiae*	Not Threatened
Common Chaffinch	*Fringilla coelebs*	Introduced and Naturalised
Eurasian Blackbird	*Turdus merula*	Introduced and Naturalised
Grey Warbler	*Gerygone igata*	Not Threatened
Kea	*Nestor notabilis*	Nationally Endangered
Kereru	Hemiphaga novaeseelandiae	Not Threatened
Little Shag	Phalacrocorax melanoleucos brevirostris	Not Threatened
Morepork	*Ninox novaeseelandiae novaeseelandiae*	Not Threatened
New Zealand Falcon	*Falco novaeseelandiae*	Recovering
Pukeko	*Porphyrio melanotus melanotus*	Not Threatened
Silvereye	*Zosterops lateralis lateralis*	Not Threatened
Song Thrush	*Turdus philomelos*	Introduced and Naturalised
South Island Fantail	*Rhipidura fuliginosa fuliginosa*	Not Threatened
South Island Fernbird	*Bowdleria punctata punctata*	Declining
South Island Tomtit	*Petroica macrocephala macrocephala*	Not Threatened
Swamp Harrier	*Circus approximans*	Not Threatened
Western Weka	*Gallirallus australis australis*	Not Threatened

Acoustic data recorded between 13 and 26 February 2019 from Bioacoutsic Bird monitor No. 1 was processed to identify the presence of nocturnal and semi-nocturnal bird species. Data processed through *Kaleidoscope* for nocturnal and semi-nocturnal species identified the presence of both morepork and western weka within the survey area. Bioacoustic Bird monitor No. 2 located within the western forest interior failed to record due to a malfunction error (Appendix B).

Kea were the only Threatened species of bird documented; with two separate occurrences documented during independent 5MBCs. During both observation periods, one or two birds

[12] Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017: Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.

were heard calling, due north of McCulloughs creek (within a 200m range). No individuals were observed during avian survey efforts.

New Zealand Falcon were documented across the forest interior pastural area south of the project footprint. A total of three birds were documented interacting with one another vocally and through aerial displays. Their behaviour with one another was indicative of a family group, not showing aggressive territorial bouts.

Up to four South Island fernbird were seen and heard across the peripheries of the forest interior pastural area, located south of the proposed Hydro Scheme. These birds were detected in scrubby forest edge areas; within divaricating coprosma (*Coprosma* sp) and gorse (*Ulex europaeus*). Given the geographical spacing of these observations, it is likely that there are more than two territories across this area. It is to be noted that survey results did not confirm the presence of all species of conservation concern, previously identified as being potentially present (see ENZL Supplementary Ecology Report (Table 3))[13].

Table 3: Diversity of native avifauna with a conservation status higher than Not Threatened and, considered potentially within the Project area as described within the ENZL supplementary ecology report[14].

Common Name	Scientific Name	Conservation Status[15]
Black Shag	Phalacrocorax carbo novaehollandiae	Naturally Uncommon
Blue Duck	*Hymenolaimus malachorhynchos*	Nationally Vulnerable
Great Spotted kiwi	*Apteryx haastii*	Nationally Vulnerable
Grey Duck	*Anas superciliosa*	Nationally Critical
Long-tailed Cuckoo	*Eudynamys taitensis*	Naturally Uncommon
New Zealand Pipit	*Anthus novaeseelandiae novaeseelandiae*	Declining
Okarito Brown Kiwi	*Apteryx rowi*	Nationally Vulnerable
South Island Kaka	*Nestor meridionalis meridionalis*	Nationally Vulnerable
South Island pied Oystercatcher	*Haematopus finschi*	Declining

[13] Choromanski, M. Whiteley, C. 2018. McCulloughs Creek Hydropower Scheme Supplementary Ecology Report 1708124 prepared for No.8 Limited. Ecology New Zealand Ltd.
[14] Choromanski, M. Whiteley, C. 2018. McCulloughs Creek Hydropower Scheme Supplementary Ecology Report 1708124 prepared for No.8 Limited. Ecology New Zealand Ltd.
[15] Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017: Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.

Common Name	Scientific Name	Conservation Status[15]
South Island Robin	*Petroica australis australis*	Declining
Variable Oystercatcher	*Haematopus unicolor*	Recovering

3.4. Discussion

The desktop assessment described within the ENZL Supplementary Ecology Report provided insight into the diversity of avifauna species within the local area and a likelihood of presence based on expected habitat. The majority of expected species are common forest inhabitants whose presence was validated across the survey area.

South Island fernbird were confirmed within the local landscape; with several territories seemingly apparent south of the proposed Hydro Scheme. These birds were documented in an open pastural area which contained boggy wetted areas to its eastern extents and edge scrub of gorse, tea tree and divaricating coprosma. Despite South Island fernbird being noted during field surveys, the mature forested environment surrounding the projects pipeline corridor does not provide habitat thought to be suitable for fernbird. On the West Coast, these birds are usually synonymous with pakihi vegetation and reedbeds[16].

While long-tailed cuckoo (At Risk, Naturally Uncommon), were not detected during site investigations the sites mature, indigenous, forest provided suitable habitat for this species. The lack of observation or detection onsite cannot discount their presence, as early trans-oceanic migration of these birds is known to occur in February[17]. The potential for Long-tailed cuckoo presence across the site was further justified by the confirmed presence of brown creeper (*Mohoua novaeseelandiae*) onsite; one of the three species in the *Mohoua* genus, which Long-tailed cuckoo are known to nest parasitize.

South Island kaka and South Island robin are both species known to inhabit mature indigenous forest areas. Given the available habitat, it was plausible that both of these species would be present; however, they were not detected. Both of these species have distinct vocalisations which make them reasonably easy to detect where present. As robins are known to show strong territoriality and are naturally inquisitive to human presence, it is expected that if they were locally present, they would have been detected. This species usually occurs in higher population numbers in areas subject to predator control[18]. Also, with a lack of extensive pest control across the Wilberg Ecological District, kaka presence is likely patchy with lower population densities.

Neither variable or South Island pied oyster catchers were detected on-site. The likelihood of these birds being present onsite was considered low given the sites lack of suitable habitat.

---

[16] Miskelly, C.M. 2013. Fernbird. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

[17] Gill, B.J. 2013 [updated 2017]. Long-tailed cuckoo. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*.www.nzbirdsonline.org.nz

[18] Moorhouse, R.; Greene, T.; Dilks, P.; Powlesland, R.; Moran, L.; Taylor, G.; Jones, A. *et al*. 2003. Control of introduced mammalian predators improves kaka *Nestor meridionalis* breeding success: reversing the decline of a threatened New Zealand parrot. *Biological Conservation 110*: 33-44.

While neither blue duck or grey duck were detected across the survey site by ENZL, McCulloughs Creek's fast-flowing water and adjacent forested areas provide suitable habitat for both of these species. Grey duck which are most threatened by hybridisation are thought to have strongholds within forested West Coast headwaters[19]. Neither of these species have been detected during over six visits to McCulloughs Creek by the wider Project team, including initial ecological investigations by Wildlands.

There is a low likelihood of any species of kiwi being present onsite. Neither the Okarito brown kiwi or great spotted kiwi were detected, nor are they known to occur within the project area. If found present on the site, this would have proved to be a significant finding; highlighting a substantial range expansion of each of these species respectively.

New Zealand pipit have historically been detected within the wider Whataroa area; most likely across open farmland areas. A small paddock containing scattered blackberry thickets at the western flanks of the site did provide a small area suitable for foraging. It is expected that New Zealand pipit were not observed or detected across this limited area, because of the vast open farmland further west of the site which likely provides greater foraging opportunities.

Kea were the only Threatened bird species detected during survey efforts. One to two birds were detected vocalising during 5MBCs; with both detections coming from north of McCulloughs Creek. The indigenous forest within the site provides suitable foraging and nesting habitat for this species. These birds' nest in native forest below the treeline with peak egg laying between August to October[20].

4. HERPETOFAUNA

4.1. Introduction

Based on a desktop assessment, the Supplementary Ecology Report prepared by ENZL identified seven herpetofauna species, all of which were reptiles, that potentially could be present in the local area. The likelihood of their presence was also detailed in this previous report. To validate these results, ENZL undertook a combination of nocturnal spotlighting, diurnal visual encounter and manual habitat searches to detect the presence of resident herpetofauna, under the authority of a Wildlife Act permit (70661-FAU) issued by the Department of Conservation. This permit enabled lizard species to be captured for identification purposes and for genetic sampling to be undertaken for DOC species research purposes.

4.2. Methods

A total of seven hours of nocturnal spotlighting effort was undertaken across two nights with suitable weather conditions for nocturnal lizards (i.e. temperatures at approximately 15° C, no rain, low wind speeds). Spotlighting involved two experienced ecologists passively scanning terrestrial forest edge habitat for arboreal lizard presence. Careful consideration was given to forest edge tea tree, divaricating shrubs (especially those in fruit), epiphytes, flowering vegetation, and mature trees baring loose bark, cracks and crevices. Where appropriate, potential habitat features were also manually searched. Powerful headtorches (LED Lenser

[19] Williams, M.J. 2013. Grey duck. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz
[20] Kemp, J. 2013. Kea. *In* Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

H14R.2) where used during these searches; in combination with binoculars to investigate higher habitat features, potential sightings and to scan for eye shine.

Both passive and manual habitat searches were conducted across rank grassland, forest interface, forest interior, and rocky riparian stream edges. These searches involved visually scanning habitat for basking or foraging lizards. Manual habitat searches supplemented visual searches and were undertaken across suitable microhabitat features e.g. rotting logs, boulders/rock stacks/rock walls with cracks or crevices, loose bark, and epiphytes.

Areas of grassland were restricted to a small paddock on the western flank of the project area, and a paddock located within a forest interior south of the project area. Four transects of artificial cover objects (ACOs) were installed across these areas to identify the potential presence of *Oligosoma polychroma s.l and, O. infrapunctatum s.l.* ACOs were made of black onduline roofing material measuring approximately 490mm x 490mm. Each single layer ACO was positioned in the field at roughly 10m intervals. Three of four transects comprised of 10 ACO monitoring stations positioned at or near the interface of forest/riparian vegetation and grassland. The last transect was made of five monitoring stations which bisected an area of rank grassland (overgrown pasture). All ACOs were installed in the field during 12 – 14 February 2019. ACOs were inspected during the retrieval of acoustic bat and bird devices on 26 February.

4.3. Results

The site provided high quality native forest habitat for forest dwelling species including forest gecko (*Mokopirirakau granulatus,* At Risk - Declining*), Okarito gecko* (*M. "Okarito"*, Data Deficient), and West Coast green gecko (*Naultinus tuberculatus,* Threatened - Nationally Vulnerable). Pastural habitat, provided marginal but potential habitat for skink species including speckled skink (*Oligosoma infrapunctatum s.l*, At Risk – Declining), common skink (*O. polychroma,* Not Threatened), and *Canterbury grass skink (O.* aff. *polychroma* "Clade 4", At Risk - Declining).

No lizards were seen or captured during the survey period; providing no evidence of early occupancy. ACOs placed within the paddock of the western flank of the project area were subject to intensive flooding which swamped the paddock on 21st February 2019. During inspection, at least six of the ACOs were found underneath a layer of silt, and had to be dug out and repositioned. It is predicted that substantial rainfall on the West Coast during the week of 25 March 2019 would have again flooded this lower area, inundating these ACOs.

Targeted manual habitat searches and spotlighting failed to detect the presence of any skink or gecko species. In addition to mature vegetation, divaricating and scrub vegetation across forest edges provided ample areas where arboreal species would have been easily detected. Ample invertebrate food sources were documented (high numbers of Lepidoptera and diptera), with congregations of these found on flowering rata (*Meterosideros perforata*) and Easter orchid (*Earina autumnalis*). In addition to this, abundant seasonal fruit was noted on mingimingi (*Coprosma propinqua* var. *propinqua*) during the site investigations.

4.4. Discussion

Lizard habitat across the site primarily consisted of mature forest habitat, a small area of pastural habitat west of the site and impermanent rocky edges of the McCulloughs Creek channel. The available forest habitat was considered high quality, providing most suitable habitat for forest inhabitant species; specifically, forest gecko, West Coast green gecko and Okarito gecko. Rocky edges of the McCulloughs creek could provide suitable habitat for terrestrial lizard species. The dynamic nature of the watercourse does however see these areas rapidly flood in short periods of time, thus reducing its suitability. A small paddock located west of the site, did provide marginal pastural habitat for skink species; containing rank grass, scattered blackberry and gorse. During investigations, this lower altitude pastural area was noted to completely flood; once occurring on 21 February 2019, and likely again on the week of 25 March 2019 where rainfall exceeded that of 21 February 2019.

In light of the potential lizard diversity across the local landscape and available onsite habitat, species with the highest potential on site are forest inhabitant gecko species. Specifically, the species with the highest likelihood of presence on site is the forest gecko. Multiple records of this species exist 20km west of the project area, within the Okarito area. In addition to forest gecko, Okarito gecko likewise show historical presence within the Okarito area. However, this species is only known from less than five observations, and is classified as Data Deficient. The probability of detecting this species has previously been considered low. but is unsubstantiated. The presence of Okarito gecko within the project area would represent a significant range expansion for this species; making the entire forested area of the Wilberg Ecological District potential habitat. Records of West Coast green gecko (Threatened, Nationally Vulnerable) are sparsely distributed from the Lewis Pass area to northern Westland, with notable populations occurring in Stockton and Denniston[21]. This species has not been recorded within 50km of the project area nor do substantiated records of green gecko exist this far south on the West Coast (R. Hitchmough, personal communication, August 2018). Strewn unproven records of green geckos (expectantly *N. Tuberculatus* s.l) exist southward to Haast, potentially demonstrating a range expansion for this species rather than a new taxa or a westward range expansion of *Naultinus gemmeus* which is currently distributed east of the southern alps[22,23].This species is found occupying a range of habitats including scrubland, fernland, shrubland and mature forest where they usually inhabit the forest canopy. With the exception of the notable populations above, populations generally occur in low densities but are expected to occur semi-contiguously across the above-stated habitat types across their range[20].

Detecting lizards within a mature forest environment is a difficult task. Observing small, extremely well camouflaged animals which demonstrate cryptic behaviours is further complicated when attempting to detect them in a vast expanse of habitat containing complex microhabitats. It is considered that this is one of the contributing reasons for why historical lizard records across the West Coast are sparse and scattered. Though available historical records can provide predictions of species presence, a lack of exhaustive survey effort and difficulties in detection means that a true representation of species diversity and abundance is difficult to ascertain.

---

[21] Department of Conservation Atlas Species information. https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution

[22]Whitaker, A.H. 2013. An Assessment of the Potential Effect of the Proposed Waitaha Hydro Scheme on the Lizard Fauna of the Lower Waitaha River, Westland. Whitaker Consultants Limited;

[23] Whitaker, T.; Lyall, J. 2004: Conservation of lizards in West Coast/Tai Poutini Conservancy. Department of Conservation, Wellington. vii + 93 p.

5. FISH

5.1. Introduction

The Supplementary Ecology Report prepared by ENZL identified all fish species known within the wider Whataroa River as being potentially present within the impact site on McCullough Creek, and assessed the likelihood of these species being detected. To confirm and validate this desktop analysis a field survey was undertaken using both active and passive sampling methodologies in accordance with the New Zealand Freshwater Fish Sampling Protocols for Wadeable Rivers and Streams[24]. Additionally, 1D modelling was carried out to assess current instream habitat availability and predict future habitat availability under an expected flow reduction.

5.2. Methods

The passive sampling methodology included the placement of both Gee Minnow traps and fyke nets within a reach extending from the proposed project outfall to approximately 850m upstream. This ensured that traps/nets were placed in all available habitat types and above an identified potential migration barrier. 10 Gee Minnow traps and three Fyke nets were placed along the sampling reach with placement targeting different habitat types. Trapping was undertaken over two nights with unbaited traps placed the first night and baited traps placed the second night.

To actively sample the local fish community, electric fishing was carried out. Electric fishing was carried out using an EFM300 backpack electric fishing machine. Multiple passes were completed within three sections being fished within the lower portion of the reach and one section being fish within the upper section at the proposed intake site. The electric fishing machine temporarily stuns fish, allowing them to be captured were they can be identified to species and measured

To assess current instream habitat availability and future potential instream habitat availability, a habitat assessment was carried out that examined various abiotic parameters (depth, bank width, velocity, substrate etc.). The assessment was carried out using the various methodologies outlined in the NIWA document *A Guide to Instream Habitat Survey Methods and Analysis*[25]. In total, 10 cross sections were randomly selected (with the limitation of access constraints) over the length of the impact reach, to represent the available instream habitat types. The abiotic parameters at each site were assessed and recorded. This data was then collated and processed through the Program SEFA (System for Environmental Flow Analysis) to provide a model of the current and theoretical habitat available within the proposed impact reach.

5.3. Results

5.3.1. Fishing Survey

[24] Joy, David, Lake, 2013, New Zealand Freshwater Fish Sampling Protocols for Wadeable Rivers and Streams.

[25] Jowett, Hayes, Duncan, 2008, A guide to instream habitat survey methods and analysis, NIWA Science and Technology Series No. 54 121p.

As detailed within the previous report, the site provided significant habitat for any species adapted to living in a dynamic high energetic stream. The more extensive survey effort undertaken in February 2019 detected the presence of four species of fish. Three native species with a conservation status of At-Risk Declining, one introduced and naturalised species (Table 4).

Table 4 Summary of all fish caught within the February 2019 field surveys.

Common Name	Scientific Name	Conservation Status	Number Caught	Minimum Length	Maximum Length
Upstream of Natural Barrier					
Koaro	*Galaxias brevipinnis*	At-Risk Declining	8	100 mm	160 mm
Downstream of Natural Barrier					
Koaro	*Galaxias brevipinnis*	At-Risk Declining	52	80 mm	200 mm
Torrentfish	*Cheimarrichthys fosteri*	At-Risk Declining	9	50 mm	110 mm
Longfin eel	*Anguilla dieffenbachii*	At-Risk Declining	2	250 mm	300 mm
Brown trout	*Salmo trutta*	Introduced and Naturalised	1	70 mm	70mm

Overall catch success was high, with 9 of the10 Gee Minnow traps deployed capturing native fish (Appendix C, Table 18). There was no significant difference between baited and unbaited methodologies with 11 koaro captured in baited traps and 13 koaro captured within unbaited. Two of the three fykes deployed captured fish, with the fykes capturing all four of the native species of fish detected within the site. The four electric-fished reaches only detected koaro and torrent fish.

Koaro were noted as the most abundant species throughout the survey reach with 60 individuals caught. Torrent fish were the next most abundant species with a total of 9 individuals caught throughout the reach. The two longfin eels and one brown trout caught only appeared within the lower portion of the reach.

The first of a set of natural barriers to upstream fish migration was noted approximately 650m upstream of the proposed outfall. This natural barrier was characterised by a >2m high vertical drop and a relatively shallow plunge pool of <1.5m deep. These two combined features would result in a significant challenge, for jumping, non-native species such as brown trout, to migrate upstream. Additionally, this physical feature would provide a challenge to all but the strongest native, climbing species attempting to migrate upstream. Upstream of this feature additional barriers were noted and characterised as cascade and shallow pools. Therefore, should any species succeed in overcoming the first barrier, it is unlikely species other than the strongest of native climbers could pass these subsequent barriers which, occur in short succession as the stream morphology changes into more cascade characteristics.

Two Gee Minow traps and one electrofishing survey was undertaken within the zone above the first natural barrier. The only species captured upstream of this barrier was koaro. It is to be noted that although torrent fish were located just downstream of the barrier, they were absent directly upstream, further strengthening the theory of natural barrier exclusion, given torrentfish' poorer climbing ability. Further survey effort was prevented due to the health and safety risks associated with the steep changing stream morphology and surrounding terrain.

However, the level of data collected was deemed reasonable to provide an understanding of the local fish communities above the natural barrier.

5.3.2. 1D Model

As detailed within the previous ENZL supplementary report, the impact reach can be broken into two distinct physical habitat sequences. The additional field work undertaken verified the change, from lower energetic upland pool-riffle-run sequence, to a higher energetic upland cascade-pool sequence, which occurs very suddenly at approximately 650m upstream of the proposed outfall. The result of this is that the majority of the impact reach was characterised as a cascade-pool sequence. Due to health and safety risks, the majority of the 1D cross sections were undertaken within the pool-riffle-run sequence with only two cross sections occurring within the cascade-pool sequence.

McCullough Creek flowed in a north-western direction with stream flow representative of a typical rain and snow melt fed permanent stream, commonly found in the local region. Flow rates, determined by a permanent probe data, , ranged throughout the year, with the lowest flow of 0.56 m^3/s and the highest flow of 7.24 m^3/s, between 2/3/17 to 25/9/18. These flow rates indicated a typical upland system flow regime with several flushing flows and periods of low flow. The average summer seasonal flow for McCullough Creek was recorded as 1.2 m^3/s. At the time of assessment, the calculated average flow rate across the 10 cross sections was 0.98 m^3/s which is marginally lower than the summer average. The actual flow rate at the time of assessment was likely to be higher (close to the summer average) due to two cross sections occurring at points where the stream system divides into two channels; however, this cannot be confirmed due to loss of the probe in a recent slip following a storm event.

Table 5: Seasonal averages of recorded flow rates and predicted seasonal flow (circa 0.6 m^3/s abstraction) associated with the proposed Hydro Scheme

	Current Average Flow m^3/s	Predicted Average Flow m^3/s
Autumn	1.132	0.582
Spring	1.274	0.682
Summer	1.202	0.657
Winter	1.083	0.549
Grand Total	1.170	0.615

The stream's benthic structure was typical of high energetic upland stream systems that experience periodic flushing flows. With an average of 48 % of substrate being composed of boulder and a further 26 % being composed of cobbles with the remainder made up of finer sediments (Appendix D, Table 19). The majority of these fine sediments occurred within the slower flowing areas as expected. This likely results in a significant amount of habitat space within the substrate structure which could be occupied by several of the native benthic species present within the stream.

The cross-section analysis of the reach at the time of the assessment, presented a variety of water column habitat ranges. An average of 44.5% of the water column habitat was characterised as slow flowing, shallow habitat with a flow no greater than 0.4m/s and a depth no greater than 0.4m. Only 3.5% of the assessed reach was slow flowing, deeper (<0.8m) habitat. A further 36.6% was composed of moderate flowing (0. 4 – 1.0m/s) shallow waters and

3.5% was composed of moderate flowing, deeper water column habitat. The remainder of the water column habitat was composed of fast flowing (1 - >1.4 m/s) waters (Appendix D, Table 20).

The above physical data was processed through SEFA and analysed against habitat suitability models[26] for New Zealand freshwater fish. The outputs are the theoretical area weighted suitability (AWS) which estimates the m^2 of suitable habitat for specific species. The following summarises the results for each native fish species caught (Appendix D, Table 21):

- Shortfin eels <300mm (both with and without cover): Each cross section varied with no pattern of increase or decrease in suitable habitat, either upstream or downstream direction through the reach. Cross section 7 provided the lowest AWS of 1.712 m^2/m with cross section 10 providing the highest suitable habitat with an AWS value of 7.27 m^2/m. The reach average was 4.1 m^2/m.
- Shortfin eels >300mm: The reach provided less suitable habitat for larger shortfin eels. Again, each cross section varied with no discernible pattern in suitable habitat either upstream or downstream direction through the reach. Cross section 9 provided the lowest AWS of 0.031 m^2/m with cross section 5 providing the highest suitable habitat with an AWS value of 2.554 m^2/m. The reach average was 1.108 m^2/m.
- Longfin eels <300mm: Each cross section provided similar suitable habitat to shortfin <300mm, with again no discernible pattern in suitable habitat either upstream or downstream direction through the reach. Cross section 7 provided the lowest AWS of 1.684 m^2/m with cross section 10 providing the highest suitable habitat with an AWS value of 7.368 m^2/m. The reach average was 4.1 m^2/m.
- Longfin eels >300mm: In contrast to the similarity between shortfin <300mm and longfin <300mm similarity, the AWS for longfin eels >300mm was generally lower than shortfin eels within in the same cross section. Again, each cross section varied with no discernible pattern in suitable habitat either upsteam or downstream direction through the reach. Cross section 9 provided the lowest AWS of 0.001 m^2/m with cross section 2 providing the highest suitable habitat with an AWS value of 2.904 m^2/m. The reach average was 0.931 m^2/m.
- Koaro: There was a discernible pattern with habitat suitability generally reducing in an upstream direction. One outlier is cross section 1 which occurs at the upmost section of the reach which had a higher AWS value. Cross section 5 provided the lowest AWS of 0.475 m^2/m with cross section 10 providing the highest suitable habitat with an AWS value of 5.635 m^2/m. The reach average was 3.227 m^2/m.
- Torrentfish: Each cross section varied with no discernible pattern either upstream or downstream direction through the reach. Cross section 5 provided the lowest AWS of 0.534 m^2/m with cross section 10 providing the highest suitable habitat with an AWS value of 4.511 m^2/m. The reach average was 2.604 m^2/m.
- Brown Trout: Each cross section varied with no pattern showing an increase in suitable habitat in a up or downstream direction through the reach. Cross section 5 provided the lowest AWS of 1.574 m^2/m, with cross section 10 providing the highest suitable habitat with an AWS value of 9.39 m^2/m. The reach average was 5.172 m^2/m.

[26] Jowett, Ian & Richardson, J. (2008). Habitat Use by New Zealand Fish and Habitat Suitability Models.

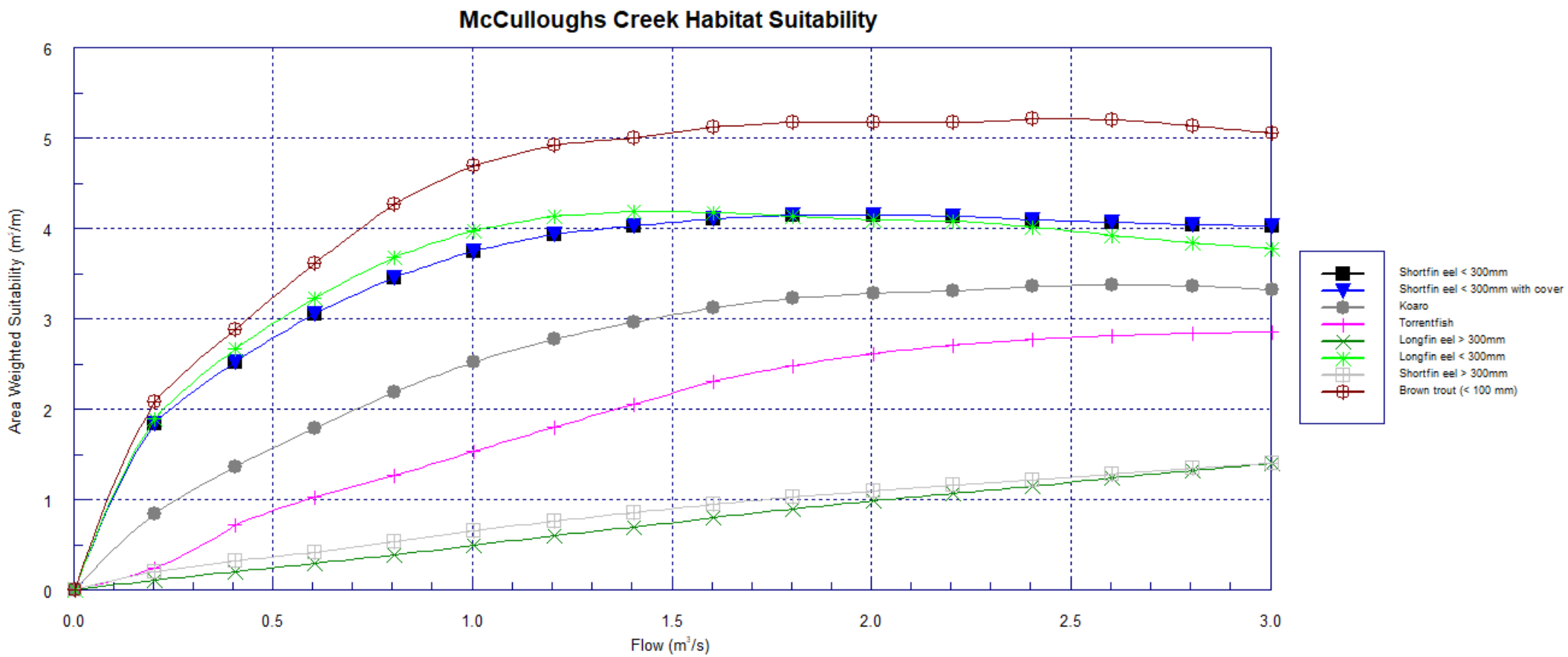


Figure 2 Estimated AWS per species as the flow rates change across the average assessed reach

.

5.4. Discussion

The lack of survey effort and variation in methodology identified previously, within DoC comments, has been addressed with a significantly increased survey effort utilising both passive and active capture methodologies throughout the reach. Through this increased effort, an additional species of longfin eel has been detected within the impact reach and the presence of the three species detected during the previous survey effort is re-confirmed. Furthermore, it has been confirmed that koaro are the dominant species within the reach based on abundance and brown trout are present, but at a low abundance, with only one individual caught.

The low abundance of brown trout throughout the reach is in contradiction to the estimated AWS, based on the 1D model. The 1D model predicts a 1.6:1 ratio of AWS between brown trout and koaro respectively. Even with vague assumptions, such as, 1m^2 of available habitat can support the same mass of fish across both species, it would be expected that around 90 brown trout would be captured given the amount of individual of koaro caught based on the catch rates. Given that captured success during both surveys was much lower than this, it can be concluded that there are external factors limiting brown trout population abundance within the impact reach. This in turn likely means that any negative effect on the catchment's native fish population due to the presence of brown trout is likely to be negligible. Anecdotally, predation on koaro by brown trout appeared to be low at the time of survey, as none of the koaro captured showed signs of predator injury/damage which, has been noted elsewhere when brown trout are present in a significant density (per comms McQueen).

Due to health and safety concerns, much of the impact reach located above the natural barrier, was not assessed or surveyed. The majority of this habitat can be described as having a large boulder, cascade and pool morphology, as noted during an aerial visual assessment. Cross sections 1 and 2 were assessed to capture a representive sample of this habitat type, with cross section 1 being more representative than cross section 2. The lack of a more comprehensive assessment of the impact reach upstream of the natural barrier, provides a reasonable shortcoming in the data. The reach above the barrier represents a large proportion of the impact reach's habitat. This is supported by the fact that AWS values for most species at Cross Section 1, were generally higher than those associated with other cross sections. While this could indicate there is a significant reach of potential habitat upstream of the natural barrier, it needs to be considered that access to this habitat is likely restricted to exceptionally good climbing species such as koaro and potentially eels, with all other species being excluded by the natural barrier.

The presence of longfin eels within the impact reach indicates it is not possible to rule out the presence of shortfin eel as both of these species occupy very similar habitat. This is further confirmed with the similar AWS predicted values. Additionally, it is likely that the population size of both species is similar and that short-fin eels managed to avoid capture during the survey. As such, the assessment of effects and ecological value assessment is to take both species into consideration.

6. AQUATIC MACROINVERTEBRATES

6.1. Introduction

The Supplementary Ecology Report prepared by ENZL identified a significant data gap within the published data for macroinvertebrate for McCulloughs Creek and the wider Whataaroa catchment. To address the short comings noted within DoC's response, a more extensive macroinvertebrate survey was undertaken. inconsequently, nine additional samples were collected from the instream habitat. Additional survey sites were selected to represent the widest range of habitat present within the stream system and were subjectively selected based on their spatial locations and access.

6.2. Methods

Macroinvertebrates were sampled from instream habitats to obtain semi-quantitative data in accordance with the Ministry for the Environment's current "Protocols for Sampling Macroinvertebrates in Wadeable Streams"[27]. Sampling was undertaken from representative reaches of McCulloughs creek using C1 protocols for hard-bottom streams. The samples were preserved in isopropyl alcohol, sent to the laboratory and sorted using total count to the lowest practical taxonomic level. One metric and one biotic index were calculated from the results including - total number of taxa, and the New Zealand Macroinvertebrate Community Index (MCI). Ephemeroptera, Plecoptera and Trichoptera (EPT) scores were also calculated. The EPT metric represents three orders of insects that are generally sensitive to organic or nutrient enrichment, and a high percentage of these taxa generally indicates good stream health. Macroinvertebrates in the genera Oxyethira and Paroxyethira were excluded as these taxa are not sensitive and can proliferate in degraded habitats. The MCI is based on the average sensitivity score for individual taxa recorded within a sample. MCI scores of >120 are indicative of excellent habitat quality, 100 - 119 are indicative of good habitat quality, 80 – 99 are indicative of fair habitat quality and < 80 are indicative of poor habitat quality[28].

6.3. Results

Samples were taken from nine sites as detailed below.

Table 6 Site description of all sample sites and the associated MCI Scores.

Sample Site	Description	MCI Score
MCI 1	The sample was taken just upstream of the abstraction point. The habitat was composed of fast following cascades and small gravel pools.	136.92
MCI 2	The sample was taken just below the abstraction point. The habitat was defined as a large pool system with coarse gravel and cobbles occurring throughout the pool system.	163.33
MCI 3	This sample was taken just upstream of the outfall. The sample was collected within the marginal slower flowing areas of a riffle system	168.00

[27] Protocols for sampling macroinvertebrates in wadeable streams. Stark, J.D.. Boothroyd, I.K.G.. Harding, J.S.. Maxted, J.R.. Scarsbrook, M.R.. (2001)
[28] Stark JD, Maxted JR 2007. A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No.1166. 58 p.

MCI 4	This sample was taken approximately 120m upstream of the outfall. The process involved sampling across the full cross section of the run.	155.00
MCI 5	This sample was collected at the top of the cross-section assessment area, approximately 750m upstream of the outfall. The habitat type was considered to be a pool and cascade system and was composed of deeper water with medium size gravel and the occasional cobbles	112.00
MCI 6	This sample was collected from a riffle section of the reach approximately 700m upstream of the outfall. The substrate was composed of cobbles of varying sizes and gravels.	150.00
MCI 7	This sample was collected from a deep pool on the true right side of the channel which was classified as predominately a run section. The substrate was predominately fine gravel and coarse sand. The sample site was located approximately 585m upstream of the outfall.	40.00
MCI 8	This sample was collected approximately 550m upstream of the outfall. The sample site was within a run of the stream channel. The substrate was a standard substrate mix found within the run, being composed of cobbles, gravel with the occasional coarse sand areas and odd boulders.	110.00
MCI 9	This sample was collected from a riffle section of the reach approximately 450m upstream of the outfall. The substrate was composed of cobbles of varying sizes and gravels.	130.00

The additional macroinvertebrate survey completed in February 2019 found a higher diversity of species throughout the reach, than detailed within the previous report. In total across the two survey efforts a total of 22 identified species and 27 notable taxa. Of the nine-sites sampled within the February 2019 survey, six of the sites where found to contain a sufficient number of high scoring metrics to be graded as excellent condition under the MCI , a further two sites produced an MCI score representative of good condition and the one site received a grade of poor condition.

Table 7 Summary of all macroinvertebrates caught within the February 2019 field surveys condensed from Table 22(Appendix D). Conservation status derived from Conservation status of New Zealand freshwater invertebrates, 2018.

Taxa	Scientific Name	Conservation Status	MCI Value	Total Caught
Deleatidium	*Deleatidium myzobranchia*	Not Threatened	8	272
Nesameletus	*Nesameletus austrinus*	Not Threatened	9	5
Austroperla	*Austroperla cyrene*	Not Threatened	9	3
Megaleptoperla	*Megaleptoperla grandis*	Naturally Uncommon	9	2
Zelandoperla	*Zelandoperla decorata*	Not Threatened	10	17
Costachorema	*Costachorema sp.*	Not possible to identify to species level	7	1
Edpercivalia	*Edpercivalia maxima*	Not Threatened	9	2
Hydrobiosis	*Hydrobiosis sosor*	Not Threatened	5	3
Hydrobiosis	*Hydrobiosis umbripennis*	Not Threatened	5	1
Archichauliodes	*Archichauliodes diversus*	Not Threatened	7	1
Elmidae	*Hydora nitida*	Data Deficient	6	53
Hydrophilidae		Not possible to identify to species level	5	2
Aphrophila	*Aphrophila neozelandica*	Not assessed	5	1
Austrosimulium	*Austrosimulium australense*	Not assessed	3	1
Blephariceridae	*Neocurupira hudsoni*	Not assessed	7	3
Eriopterini		Not possible to identify to species level	9	3
Maoridiamesa		Not possible to identify to species level	3	1
Orthocladiinae	*Eukiefferiella sp.*	Not possible to identify to species level	2	6
Polypedilum		Not possible to identify to species level	3	1
Sciomyzidae	*Neolimnia sigma*	Not assessed	3	1
Tanypodinae tribe Macropelopiini		Not possible to identify to species level	5	1
Potamopyrgus	*Potamopyrgus antipodarum*	Not Threatened	4	1

6.4. Discussion

As expected, the results of the macroinvertebrate survey indicate that the current available habitat within the stream channel is considered excellent to good. The stream exhibits relatively high macroinvertebrate diversity, relative to the stream morphology, with most of the survey sites containing between 6 – 4 species. Streams which experience regular flushing due to a periodic, high flow regime, naturally have a lower diversity of macroinvertebrates than

that found in less energetic streams. This is in large part due to the constant shifting of substrate, reducing the stability of the benthic habitat and thus establishment of a more diverse community.

The majority of the identifiable species (13) sampled have a conservation status of "Not Threatened". A further six were either not assessed within the recent conservation status report or "Data Deficient". While the prevalence of species with a "Not Threatened" status suggests the overall conservation risk may be low, it is not possible to rule out the presence of species with a "Threatened" status. However, it is the authors opinion that given the significant effort undertaken and the previous documented comms with Brian Patrick "*In general, Threatened and/or At Risk macroinvertebrate species are more likely to be found in seepages, headwaters and small tributary systems*" and as such it is unlikely that threated species occur within the main channel of McCulloughs Creek.

7. ECOLOGICAL IMPACT ASSESSMENT

7.1. Westland District Plan

Section 4.9 of the Westland District Plan specifies four policies which guide the use of natural habitats and ecosystems within the local district. Policy 4.9 D specifically details the protection of indigenous vegetation and significant habitats which meet a subset of significance criterion (Table 8). The following explanations detailed in Table 8 have considered the findings of the Wildlands Assessment of Ecological Effects report for the project.

Table 8 Ecological significance assessment following criteria as detailed within Section 4.9 - Policy D, of the Westland District Plan

Criterion and Definition	Criteria Achievement	Explanation
(i) <u>Intactness:</u> The area is unmodified by human activity, comprises a predominantly intact indigenous system and is not affected in a major way by weed or pest species; AND **<u>Size</u>** The area of indigenous vegetation has a predominant cover of five hectares or more.	**Achieved**	The sites terrestrial and freshwater environment remains principally free of anthropogenic impacts and is dominated by native species. The freshwater environment shows uninterrupted contiguity between the upstream and downstream environment. The forested terrestrial environment which the project is located, is well in excess of 5ha and shows complete contiguity across the Wilberg Ecological District.
(ii) Representativeness The area is one of the best examples of an association of species which is typical of its ecological district.	**Unknown**	The site does demonstrate terrestrial and freshwater species that are typical of the ecological region. A full assessment of the wider ecological district is outside the scope of this assessment; therefore, it is unknown whether the site represents the best examples of an association of species typical of

		the ecological district. A robust significant natural areas assessment has not yet been undertaken for the area.
(iii) Distinctiveness The area has indigenous species or an association of indigenous species which is unusual or rare in the ecological district, or endemic or reaches a distribution limit in the ecological district. The area may be distinctive because of the influence of factors such as altitude, water table, soil type or geothermal activity.	**Unknown/Achieved**	The area does not contain any vegetation types or associations of species that are unusual or rare, either in the Wilberg Ecological District or nationally. Long-tailed bats that may be considered rare in the district were detected on site. Robust surveys have not been attempted across the district to determine key habitat areas for this species. Lizard species were not detected on site; however, their presence is not to be completely discounted. The area does not contain any plant or animal species at their national distribution limits.
(iv) Protected Status The area has been set aside by New Zealand Statue or Covenant for protection and preservation or is a recognised wilderness area.	**Achieved**	The project area is located on protected public conservation land. These being the Whataroa Scenic Reserve (769 ha) and Waitangi Forest Stewardship Area (57,326 ha).
(v) Connectivity The area is connected to one or more other significant areas in a way, (including through ecological processes) which makes a major contribution to the overall value or natural functioning of those areas.	**Achieved**	The sites terrestrial and freshwater features are contiguous with adjoining features. Terrestrial habitat on the site is adjoins to adjacent mature forest; providing connectivity for mobile species, facilitating ecological services such as seed dispersal and pollination. The McCulloughs Creek flows directly into the Whataroa River, providing migratory connection for native fish and aquatic invertebrates.
(vi) Threat The area supports an indigenous species or community which is	**Achieved**	<u>Threatened Species:</u> ▪ Kea, and ▪ long-tailed bat

threatened within the ecological district or threatened nationally.		At Risk Species: ▪ New Zealand falcon ▪ South Island fernbird ▪ Koaro ▪ Torrent fish ▪ Longfin eel
(vii) Migratory Species An inter-tidal area or area of forest, wetland, lake, estuary or other natural habitat that is important for migratory species or for breeding, feeding or other vulnerable stages of indigenous species.	**Achieved**	McCulloughs Creek is a tributary of the Whataroa River and provides important habitat for indigenous fish species that migrate within the catchment and between the freshwater and marine environments. The Creek provides essential feeding and breeding areas for fish, and a connection between lowland and alpine habitat.
(viii) Scientific or other Cultural Value The area is a type, locality or other scientific reference area, is listed as a geo-preservation site, or has a distinctive amenity value (e.g. it contributes to a distinctive and outstanding landscape of the district, has other significant cultural value or is of international importance).	**Achieved**	Torrent fish are listed as a taonga species under the Ngāi Tahu Claims Settlement Act 1998.

7.2. Terrestrial Ecology

7.2.1. EIANZ Values Assessment

The following assessment detailed in Table 9 and Table 10 has been guided by four key matters as described within the EIANZ EcIA guidelines. Each of these four matters has been assigned a value between 'Negligible' to 'Very High'. The assignment of each matter's value is explained through a description of key associated attributes. An overarching value for the sites terrestrial ecological features has then been assigned by combining the results of each matter's values (Table 9).

Table 9 Ecological values assessment as per Table 4 of the EcIA EIANZ guidelines, 2018

Matters	Assigned Value	Attributes
Representativeness	**HIGH**	Though some impacts on the site's vegetation are apparent from introduced animals, the vegetation structure and composition are in general, typical for the ecosystem types present. Indigenous species were dominant across the site. Introduced plants were limited to four main species (*Hypochaeris radicata, Ulex europaeus, Leycesteria Formosa,* and *Rubus fruticosus* agg.). Introduced fauna were limited to mainly a small proportion of the bird diversity detected (section 3.2). The presence of large specimen trees gives indication of an unmodified landscape (e.g. free from logging and fires). Species assemblages and their distribution are typical of the ecosystems present and were as predicted during desktop assessments.
Rarity/distinctiveness	**MODERATE**	The site does not contain originally rare ecosystems[29] or ecosystems/habitats that are underrepresented within the Wilberg Ecological District. The site does provide terrestrial habitat for a number of Threatened and At-Risk species which were identified during surveys (I.e. long-tailed bat, kea, New Zealand falcon, and South Island fernbird).
Diversity and Pattern	**MODERATE**	At a landscape level, ecosystem diversity was in general low, with the dominant ecosystem being mature indigenous forest. At a finer scale, five vegetation types were identified by Wildlands ranged from *Olearia / Carmichaelia / Chionochloa / Carex / Uncinia* grassland to Coriaria

[29] Wiser, S. K., Buxton, R. P., Clarkson, B. R., Hoare, R. J., Holdaway, R. J., Richardson, S. J., ... & Williams, P. A. (2013). New Zealand's naturally uncommon ecosystems. *Ecosystem services in New Zealand: conditions and trends. Manaaki Whenua Press, Lincoln*, 49-61.

		/ Aristotelia / Schefflera / Fuchsia / Hedycarya forest[30]. Landscape level patterns in ecotone transitions are largely absent across the site. This is due to distinct changes in forested foothills to agricultural pasture on the project's western extents, and due to the fact that the project does not extend to the higher altitude treeline where alpine vegetation switches are apparent. The interface of McCulloughs creek with the terrestrial environment, did display a Riparian to forest ecotone. This ecotone was predominantly abrupt; in part due to the steep streamside channel morphology (i.e steep bluffs).
Ecological Context	**MODERATE (scaled up due to unknown provision of critical breeding habitat and unknown presence of herpetofauna species)**	The sites terrestrial vegetation will in part provide ecosystem services to McCulloughs Creek. These include factors such as water retention, shading, filtration, detritus provision, all of which act to facilitate hydrology, water quality and resource provision to aquatic values. The sites vegetation acts to provide contiguity with the adjoining forest environment. This contiguity acts to reduce edge effects such as weed incursion. The footprint of the proposed activity represents less than <0.001% of the total area of indigenous forest (27,345 ha) in the Wilberg Ecological District. It is unknown if the site contains critical breeding habitat for threatened fauna (current data indicates not for bats). Long term research on populations and taxa was not considered appropriate for this scope of works. Habitat as a proxy, indicates that the site provides a negligible extent of area in context of the contiguous forested Wilberg Ecological District.

[30] Hutchinson, M. McCaughan, H and Patrick, B., 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205. Wildlands Consultants

Table 10 Overall terrestrial values assessment for the site

Value of Matters Assessed	Overall Value	Attributes
HIGH – Representativeness **MODERATE –** Rarity/distinctiveness **MODERATE –** Diversity and Pattern **MODERATE –** Ecological Context	**HIGH**	Area rates as High for 2 of the assessment matters, Moderate and Low for the remainder or Area rates high for 1 of the assessment matters, Moderate for the remainder.

7.2.2. EIANZ Magnitude of Effects Assessment

The following magnitude of effects assessment, and summarised in Table 11, has been guided by Chapter 6 of the EcIA EIANZ guidelines. This assessment takes into consideration the extent and scale of the impacts and the degree of change that it will cause to native birds, bats and herpetofauna populations. Given the site is situated within contiguous mature forest which makes up the majority of the Wilberg Ecological District, the assessments have been undertaken in this context.

Though considered appropriate for the proposed levels of effect, uncertainty in the results of fauna surveys arises due to the level of effort employed. Without intensive and multi-season surveys (e.g. radiotracking kea and long-tailed bats or exhaustive forest herpetofauna surveys), the true extent of the value of the site as a key resource to species of conservation concern cannot be truly recognised at a fine scale. It is recognised that in some cases, the level of effort required to provide this detail is not realistic (e.g. attempting to catch and track bats in an area where activity levels are very low) and as such is not considered appropriate. To address this level of uncertainty, assessments are based on habitat as a proxy for species presence with refinement taken from the results of implemented field surveys.

At a conservative level, the project will see the permanent loss of approximately 5000m^2 of indigenous forest habitat. This would largely be attributed to the establishment of a vehicle access to the powerhouse and a corridor for the pipeline/penstock and associated foot access. As the Hydro Scheme footprint is situated within an expansive tract of contiguous forest, the extent to which it will impact this contiguous terrestrial ecosystem is considered negligible at the landscape level. This is quantified by the proposed works projecting to impact <0.001% of the total area of indigenous forest (27,345 ha) in the Wilberg Ecological District.

One of the most significant elements that exists within the project footprint is that of mature indigenous specimen trees. These long-lived specimen trees contain important micro-habitat features such as large epiphyte clumps, hollows, and loose bark that are known to be utilized by native bats, birds and herpetofauna. Although these mature trees are abundant across the local Willberg Ecological District these features cannot be replaced in the short-term. It is for this reason; careful consideration of these trees is required.

The creation of an approximately 1.5 – 2 m wide corridor commencing on pastural farmland on the western foothills of the site and continuing east to the location of the intake, will expectantly result in negligible fragmentation effects on assessed terrestrial fauna species (i.e bats, birds, and herpetofauna). This corridor will be set within the forest interior and only comprise of a narrow width, making it highly unlikely that mobile species will be perturbed with crossing this short distance. This is especially in light of the dynamic forest environment in which the project is located, where wind throw and snow damage often lead to open area in the forest (as seen on site). In addition, this corridor does not completely bisect forested areas, with contiguity still retained upstream of the intake area. It is anticipated that highly mobile species such as forest birds and bats could utilise this corridor for foraging and commuting.

Though anticipated to already be ubiquitous across the local landscape, this corridor may be utilized for movement by introduced pest mammals and be vulnerable to localised incursion from pest plant species if light gaps are created.

Temporal impacts on terrestrial fauna will be highest during the construction phase of the project. Effects will largely occur from the direct clearance of habitat and disturbance of adjacent retained habitat from noise and vibration occurring from vegetation clearance, helicopters and machinery operation. It is expected that this more intrusive disturbance will only occur over one construction season. On-going impacts associated with the Hydro Scheme will occur from low levels of foot traffic along the pipeline/penstock corridor for maintenance purposes and the on-going noise generated from the operation of the powerhouse. The operational sound of the powerhouse will be mitigated by its locality which positions it directly adjacent to McCulloughs Creek which generates considerable natural background noise.

Table 11 Summary of expected magnitude of effects on terrestrial ecosystems

Magnitude	Descriptions
Negligible	Very Slight change from the existing condition. Change barely distinguishable, approximating to the 'no change' situation; AND or Having a negligible effect on the known population or range of the element/feature.

7.2.3. EIANZ Overall level of Unmitigated Effects

To describe the overall level of effects, the scores assigned to ecological value (Table 10) and the magnitude of effect (Table 11) is assessed against a matrix detailed in Table 8 of the EcIA EIANZ guidelines. Based on an overall 'High' ecological value, and a 'Negligible' magnitude of effects, the overall level of unmitigated effects has been assessed as 'Very Low'.

Table 12 Summary of overall level of unmitigated effects

Ecological Value Magnitude	**HIGH**
Negligible	Very Low

This overall 'Very Low' level of unmitigated effects is largely attributed to the sensitive manner which the project has been designed I.e. small-scale and low impact. A refined footprint and construction methodology have avoided the need to require a wide footprint designation to enable construction activities and unnecessary roading along the entire length of the pipeline for ease of maintenance.

Despite this assessment being undertaken based on a complete vegetative loss situation, a refined route selection, in consultation with an ecologist, will aim to mitigate impacts through avoiding significant terrestrial features such as larger specimen trees or ground cavities i.e potential kea nesting habitat. This is especially important across the lower sections of the corridor where piping material is less pliable and requires a more linear path. The low-pressure pipeline to be constructed in the upper extents of the corridor, will be made of high-density polyethylene material. This more flexible material will enable a higher degree of route plasticity; acting to facilitate the avoidance of significant terrestrial features during the final route selection phase. It is envisioned that this flexibility during construction will act to allow the

avoidance of key habitat features; mitigating potential impacts on fauna, especially those where uncertainty of their presence remains.

Though the overall level of effect has been assessed as very low, further consideration is required around the level of uncertainty attributed to the results of fauna surveys. To address this, it is considered that appropriate mitigation measures be employed to reduce potential impacts on Threatened species; specifically, long-tailed bats and kea. This may be achieved through surveys of high-risk habitat being undertaken immediately prior to clearance. Though the presence of native herpetofauna on site is unknown, recommended vegetation clearance methodologies would advocate felled vegetation relocation and avoid mulching and chipping; mitigating actual risks of injury and death.

7.3. Freshwater Ecology

7.3.1. EIANZ Values Assessment

Table 13 Ecological values assessment as per Table 4 of the EcIA EIANZ guidelines, 2018

Matters	Assigned Value	Attributes
Representativeness	**HIGH**	The McCullough Creek is a high quality glacial alpine stream. The impact reach has no detectable anthropogenic influence and at present is in a pristine state. The McCullough Creek is a permanent 3rd order stream system with an estimated total catchment of 15km^2
Rarity/distinctiveness	**MODERATE**	The site provides aquatic habitat for a range of nationally threatened species (i.e.longfin eel, torrentfish and koaro). The stream is additionally noted to be a glacial, high energetic, boulder stream, which is not distinct within the local region but is regarded as nationally distinct.
Diversity and Pattern	**HIGH**	The assessment site presented a diverse range of macroinvertebrates considering the natural characteristic of the site. Majority of the sites scored excellent and good condition MCI scores. With regards to fish, the diversity is considered high given that, of the five species that would be reasonably expected to have access to the site and could potentially utilise the available habitat, four were detected within the reach.

Ecological Context	**HIGH**	The sites freshwater ecosystem, provides a highly diverse stream system. There is a diverse range of substrate present throughout the site and a range of instream habitat types. The riparian margin around the impact reaches or zone is completely intact with the margin exceeding well over 20m in width on both banks. Filtration activity within this riparian margin is expected to be high. This is reflected within the water quality values which are noted as high. There is no evidence of any anthropogenic interference within the current system. The fauna communities within the freshwater environment appear to be adapted to the highly dynamic system and show a high level of resilience to the current prevailing abiotic factors. The site additionally provided breeding and feeding habitat for threatened freshwater species.

Table 14 *Overall freshwater values assessment for the site*

Value of Matters Assessed	Overall Value	Attributes
HIGH – Representativeness **MODERATE –** Rarity/distinctiveness **HIGH –** Diversity and Pattern **HIGH –** Ecological Context	**HIGH**	With 3 of the 4 Value Matters rated as HIGH, the freshwater ecosystems overall within the site are to be considered of high value

7.3.2. EIANZ Magnitude of Effects Assessment

The following magnitude of effects assessment detailed below and summarised in Table 16 Summary of expected magnitude of effects5, has been guided by Chapter 6 of the EcIA EIANZ guidelines. This assessment takes into consideration the extent and scale of the impact and the degree of change that it will cause to fish and macroinvertebrate communities and the physical abiotic parameters of the freshwater ecosystem. The assessment takes into account the impact and change within the context of the immediate impacted reach and the wider connected environment, in this case the wider Whataroa River catchment.

Local Impact

The Hydro Scheme proposes a gradual abstraction of flow from the impact reach of McCullough Creek ranging from 60L/s up to 600L/s. The abstraction of 25% of the Mean Annual

Low Flow (MALF) is accepted as permissible[31],. Therefore, the permissible, theoretical low flow is circa. 252L/s. This low flow rate will be maintained as the abstraction increases to the upper intake level of 600L/s. The gradual abstraction of up to 600L/s from the impacted reach will result in a significant shift in flow dynamics with the majority of flows leaving the abstraction site at 252L/s.

This reduction in flow caused by the abstraction will result in the reduction of available habitat for the various species using the impact reach. Using 1D modelling the extent of the habitat reduction can be theoretically assessed to determine the impact on individual species.

As detailed within the previous supplementary report, it was theorised that composition of the impact reach can be broken down into a "V-shaped stream system" and a "U-shaped stream system" as detailed within section 5.4. The additional assessment undertaken in February 2019 was focused on the first 850m of the impact zone, which can be characterised as the lower reach and fits the predominately "U-shaped stream system" description. Only cross section 1 is representative of the majority of the impact zone, which fits the predominately "V-shaped stream system" description.

The 1D model shows, all species see a reduction in available habitat as the reduction of flows reduce the available benthic area and water column habitat. This reduction results in a loss of 33% and 35% of available habitat, for koaro and torrentfish respectively (Table 15). When looking cross section 1 the reduction in available habitat for Koaro is 26%. With this factored in, the local impact on koaro, in terms of habitat reduction, is expected to be marginally lower than that predicted by the 1D model; however, in the absence of more cross sections and site-specific data, a conservative approach will be adopted and the higher estimated reduction is to be used.

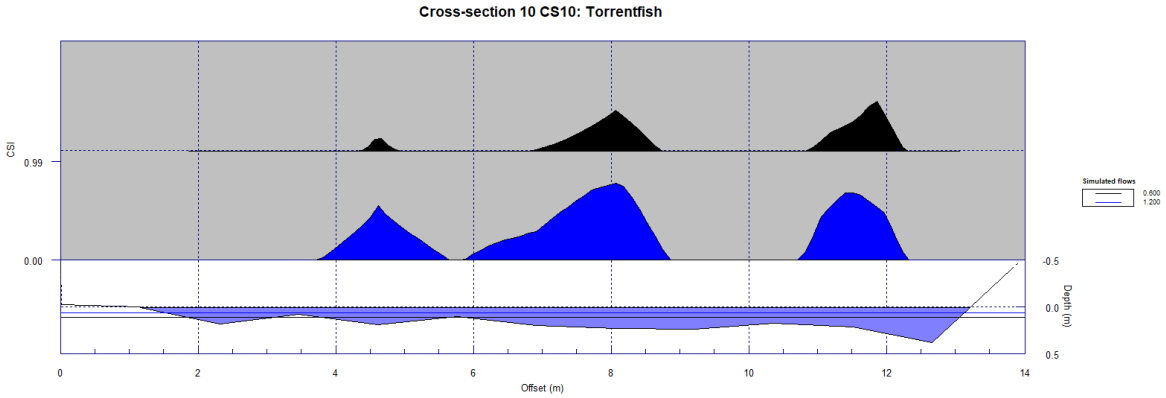
Table 15 Current AWS values and predicted AWS values based estimated average flows for all species occurring within the impact reach. Note values derived from Figure 2

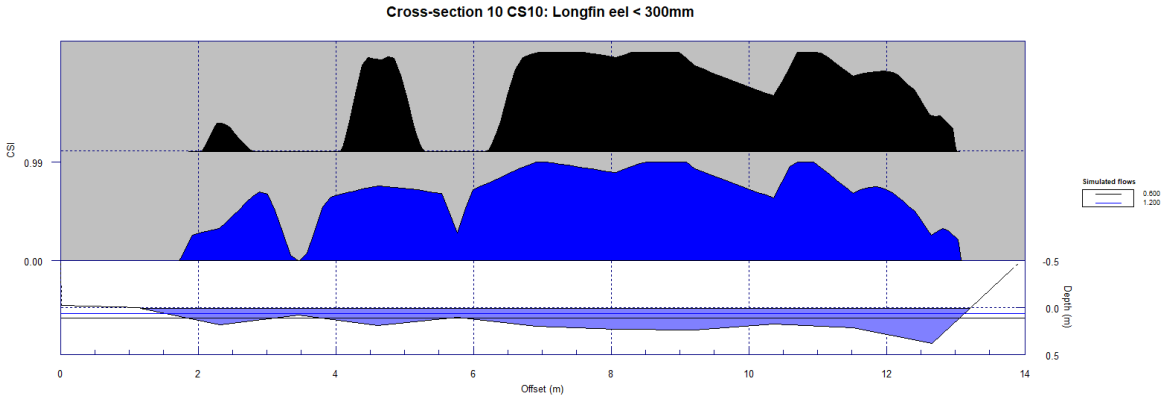
Species	Current AWS at Average Flow Rate ($1.17m^2/m$)	Predicted AWS Average New Flow Rate ($0.6m^2/m$)
Koaro	2.7	1.8
Shortfin eel	3.9	3.0
Longfin eel	4.1	3.2
Torrentfish	1.7	1.1
Brown Trout	4.8	3.6

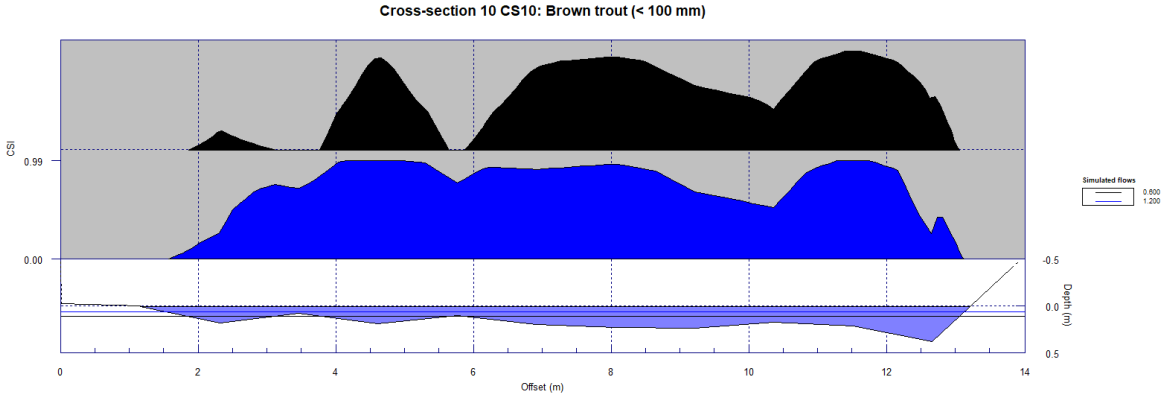
Koaro and torrentfish are noted as the most abundant species caught within the impact reaches with eels and brown trout being noted in low density. It is therefore assumed that the reduction in habitat will have an impact on the current local populations of Koaro and torrentfish and will likely result in a reduction in population size. However, in regards to eels and brown trout the reduction in habitat is theorised to have no detectable impact on the local populations, given that the species are not currently utilising the full extent of available habitat. The magnitude of the local impact on freshwater fish is assessed below in conjunction with the impact at the catchment level.

[31] Choromanski, M. Whiteley, C. 2018. McCulloughs Creek Hydropower Scheme Supplementary Ecology Report 1708124 prepared for No.8 Limited. Ecology New Zealand Ltd.

Given the diversity of macroinvertebrates present throughout the impact reach and the noted resilience of this community based on its ability to recover rapidly from high flow events, the impact of the proposed Hydro Scheme on this community is expected to be negligible. While the invertebrate community is likely to experience a reduction in available habitat, the community will also have a reduction in predation with fish likely being excluded from a greater area of habitat, based on cross section analysis and observed habitat usage by macroinvertebrates on site (Figure 3). Additionally, given the highly likely absence of threaten species it is unlikely that this change in flow and habitat implication will result in the loss of any invertebrate species from the impact reach.







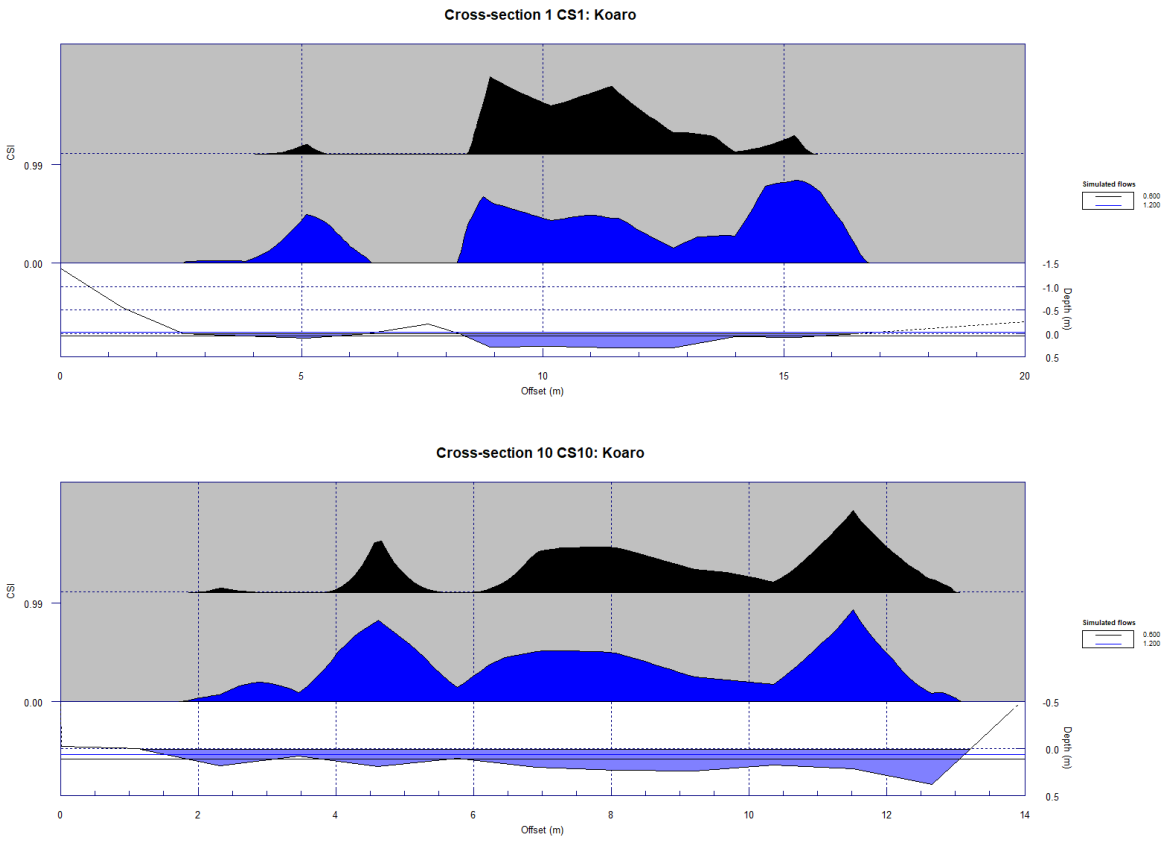


Figure 3 Shows Cross Section habitat suitability analysis of all species at Cross Section 10 and koaro at Cross Section 1 and compares the current predicted habitat suitability against the reduce flow predicted habitat suitability

With all of this considered the impact of the reduction in habitat for aquatic fauna within the local impact reach is expected to be moderate due to the reasonable loss of potential fish habitat.

The reduction of flow is unlikely to have any impact on the migration of species at key life stages. The lower 850m of the impact site has no potential barriers that could be expected to emerge with a reduction in flow.

The reduction in flow is unlikely to have any impact on the sediment transport and flushing flows that characterise freshwater systems such as McCulloughs Creek. These high flows are often required to maintain some of the aquatic habitat qualities present within the impact site (as noted within the supplementary report). Therefore, the effect on maintenance flows within the impact site is expected to be negligible.

The potential for fish injury and mortality due to interactions with proposed Hydro Scheme infrastructure, such as the water intake fish screen, is considered low. The Coanda screen to be used is designed in a way that sweeping velocity carries fish instantly off the screen. There is potential for this design to occasionally result in fish skin abrasion. The current research, as outlined in the AEE, and Wildlands report, shows promising results on salmonid passing over the screens without any major effects on the individuals. The proposed Hydro Scheme system is designed to maximise avoidance of fish mortality and minimise injury. While, the full impact on fish communities cannot be fully assessed, current surveys and findings, as documented within this report and previously submitted reports, indicate that the impact is expected to be low.

Catchment Impact

The McCullough Creek forms a tributary of the wider Whataroa River catchment. The Whataroa River catchment has an approximate area of 445 km^2, with >300km of flowing streams and rivers (based on topo maps assessment) and over >100 noted tributaries that drain the wider catchment. In terms of habitat loss for fish species within the catchment, the proposed habitat reduction will represent a loss of<0.35% of available habitat for any of the species noted within the impact site. Given the remote nature of the majority of the catchment, any cumulative impact associated with additional habitat loss is considered low. Overall the impact of this project on the available habitat of the wider catchment is considered negligible.

Given the reduction in habitat is considered to be negligible the expected effect on the reproductive potential across the catchment for any one species is likely be non-detectable. The proposed Hydro Scheme will not alter the natural migratory pathways of any of the species present and thus does not establish any genetically isolated populations or dilute any genetically isolated populations. Overall the impact on the life-cycles of the aquatic fauna within the wider catchment is considered negligible.

There will be no effect on the overall flow rate entering the wider Whataroa River catchment as the abstracted flow is proposed to be returned to the catchment with no additional loss attributable to the Hydro Scheme expected.

Overall Magnitude

While the impacts are considered moderate within the local site, the dilution of these impacts once applied throughout the catchment, results in an expected magnitude of effect at the catchment scale which is to be considered negligible (Table 16 Summary of expected magnitude of effects).

Table 16 Summary of expected magnitude of effects

Magnitude	Descriptions of Magnitude Based on EIANZ
Negligible	Very Slight change from the existing condition. Change barely distinguishable, approximating to the 'no change' situation; AND or Having a negligible effect on the known population of range of the element/feature.

7.3.3. EIANZ Overall level of Unmitigated Effects

To describe the overall level of effects, the assigned scores for ecological value (Table 14 and the magnitude of effect Table 16Table 11) are assessed against a matrix detailed in Table 8 of the EcIA EIANZ guidelines. Based on an overall 'High' ecological value, and a 'Negligible' magnitude of effects, the overall level of unmitigated effects has been assessed as 'Very Low'.

Table 17 Summary of overall level of unmitigated effects of Freshwater Ecosystems

Ecological Value Magnitude	HIGH
Negligible	Very Low

8. MANAGEMENT OF EFFECTS RECCOMENDATIONS

Under EIANZ assessment guideline's, a project that results in an overall level of unmitigated effect of 'Very Low' should not normally be of concern, although best practise design, construction and operational care should be undertaken to further minimise any unintended adverse effects. To ensure ecological sensitivity in the design and construction phase and address the levels of uncertainty in regard to terrestrial fauna presence on site (lizards and bats), the following recommendations are put forward on a conservative basis. These shall be considered for incorporation, in addition to those described within Wildlands ecological report[32].

8.1. Terrestrial Ecology

- Vegetation clearance methodologies shall not use mulching or chipping; rather where practical, cleared vegetation should be recycled into the adjacent environment. This will act to mitigate potential injury and death risks associated with cryptic arboreal lizards. If chipping or mulching is deemed necessary, subject vegetation will be required to be firstly inspected by an experienced herpetologist/ecologist to salvage herpetofauna potentially present on site.
- As At Risk and Threatened bird species have been detected within the wider project area, all vegetation clearance activities shall be undertaken outside of the peak breeding and bird egg laying season (October to January inclusive). Where vegetation clearance is required to be undertaken during this critical season, it is recommended that transect surveys, using the pipeline corridor as the centre line, be undertaken to determine the presence of any At Risk or Threatened species prior to vegetation clearance commencement. In the event An AT Risk or Threatened species are found nesting within 50m it is of the clearance area, works in that immediate vicinity shall cease. Recommencement of vegetation clearance is to take place only on the recommendation of the project ecologist. In addition, the project ecologist will work with the project team to install predator traps in the vicinity of any kea nest that may be discovered to increase the chances of chicks fledging.
- On a conservative basis, it is recommended that industry standard vegetation removal protocols are implemented for long-tailed bats. Though it is envisioned most specimen trees will be avoided through the final route designation process, it is expected that a number of trees measuring 15cm at breast height may require removal. All trees of 15cm or greater should be assessed by a competent bat ecologist as being high or low risk for bat roosting. Appendix F provides detail of these methodologies to be implemented.

  The clearance of vegetation outside of the peak bird breeding and egg laying season shall be considerate of any high-risk bat tree. Vegetation clearance is not appropriate for bats within colder months as they enter a state or inactivity (i.e torpor). It is recommended that all high-risk bat trees be left standing until the warmer months of October – April.

[32] Hutchinson, M. McCaughan, H and Patrick, B., 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205. Wildlands Consultants

8.2. Freshwater Ecology

- It is recommended that the tailrace design is updated to disperse the terminating flow through several discharge points; reducing the volume entering the stream at any one point alone. This would act to reduce the flow trigger that may result in species being drawn to the discharge point(s)
- It is recommended that a fish management plan is developed for the construction of any structures that occur within the stream, this plan should detail methodologies to salvage fish from within the stream and detail suitable times to undertaken the work to avoid key fish spawning times.

9. RESIDUAL EFFECTS ASSESSMENT

Terrestrial and freshwater fauna values have been assessed through EIANZ EcIA methodologies which have determined an overall 'Very Low' level of unmitigated effects. In general, projects which fall in this category do not trigger biodiversity mitigation, offsetting or compensation actions. Nevertheless, mitigation and avoidance recommendations detailed in this report and those within the Wildlands ecological assessment have been provided to ensure ecological sensitivity during the design, construction and operation phase of the project[33]. These mitigation measures also act to address levels of uncertainty around the potential presence of AT Risk, Threatened and/ or Data Deficient species which may be present on site. It is considered that the level of effects assessed will not result in any significant residual effects, post implementation of avoidance, mitigation and offsetting recommendations..

As this project aims to set a precedence for small-scale low impact design and ecological stewardship, ENZL has further recommended that the project considers funding the following:

- A monitoring program be developed to assess the change in population dynamics within the stream prior to and during the operation of the Hydro Scheme. This monitoring will provide key information to understand the true impacts of a small-scale low impact Hydro Scheme and how these link with estimated 1D model outputs. This monitoring data will provide future projects with additional reference material to further evaluate impacts.
- Though activity levels were very low, documentation of long-tailed bats presence across the western foothills of the site is noteworthy as it provides evidence that this species inhabits the local area. It is recommended that the project funds further bioacoustic surveys of the wider local landscape in an attempt to detect key activity hot spot areas. These areas could then be targeted for future research (e.g. trapping and tracking) and for targeted conservation efforts.

10. CONCLUSION

The low impact design of the proposed Hydro Scheme proves to demonstrate environmental sensitivity can be achieved within an intact and rugged environment. The results of this assessment highlight the quality of the environment which this project is located, and provides insight into the foreseeable level of ecological effects which can be expected.

[33] Hutchinson, M. McCaughan, H and Patrick, B., 2017. Ecological Assessment For The Proposed McCulloughs Creek Hydropower Project, Whataroa, Westland. Contract Report No. 4205. Wildlands Consultants

A series of avoidance, mitigation and offsetting measures have been provided by ENZL and Wildlands which act to ensure that the construction and operation of this run-of-the-river Hydro Scheme is considerate to the values found on site. Additional monitoring and survey recommendations have been detailed to address knowledge gaps in native bat distribution in the local area and provide more robust ecological reference material to evaluate impacts on future projects similar in nature. These recommendations are not considered to be required by the project, but demonstrate ecological stewardship towards the local environment.

APPENDIX A

Report Limitations

This Report/Document has been provided by Ecology New Zealand Limited (ENZL) subject to the following limitations:

i) This Report/Document has been prepared for the particular purpose outlined in ENZL's proposal and no responsibility is accepted for the use of this Report/Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of ENZL's services are as described in ENZL's proposal and are subject to restrictions and limitations. ENZL did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Report/Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by ENZL in regards to it.

iii) Conditions may exist which were undetectable given the limited nature of the enquiry ENZL was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Report/Document. Accordingly, if information in addition to that contained in this report is sought, additional studies and actions may be required.

iv) The passage of time affects the information and assessment provided in this Report/Document. ENZL's opinions are based upon information that existed at the time of the production of the Report/Document. The Services provided allowed ENZL to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

v) Any assessments, designs and advice made in this Report/Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report/Document.

vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by ENZL for incomplete or inaccurate data supplied by others.

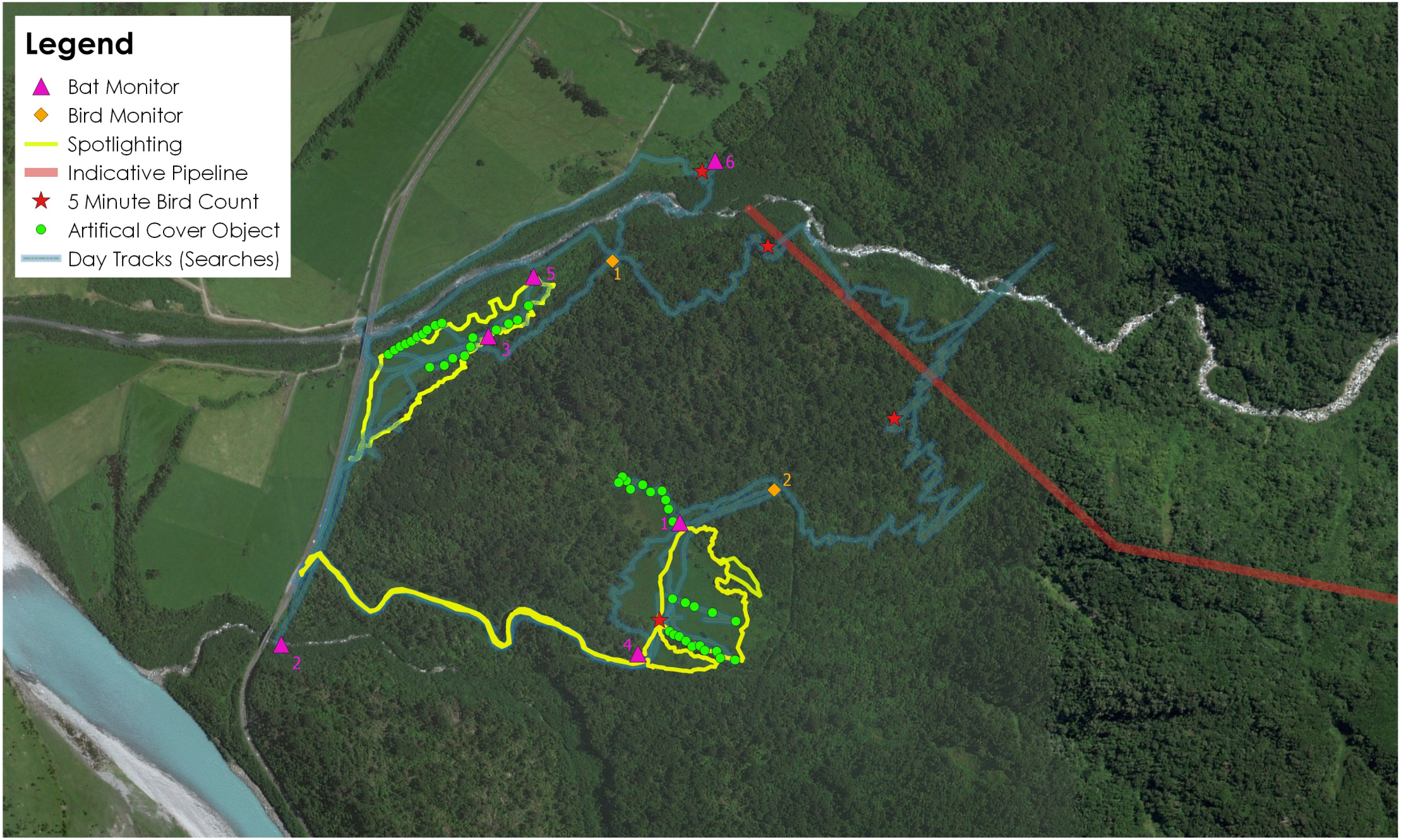
vii) The Client acknowledges that ENZL may have retained sub-consultants affiliated with ENZL to provide Services for the benefit of ENZL. ENZL will be fully responsible to the Client for the Services and work done by all of its sub-consultants and subcontractors. The Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from ENZL and not ENZL's affiliated companies. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against ENZL's affiliated companies, and their employees, officers and directors.

viii) This Report/Document is provided for sole use by the Client and is confidential to it. No responsibility whatsoever for the contents of this Report/Document will be accepted to any person other than the Client. Any use which a third party makes of this Report/Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. ENZL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Report/Document.

ix) Where lengths or other measurements have not been provided by a surveyor, ENZL has used basic GIS mapping and measurement systems to estimate these numbers. These should not be taken as surveyor-level accuracy for the purposes of decision making.

APPENDIX B

Terrestrial Field Investigation Effort



ECOLOGY NEW ZEALAND

N

0 100 200 300 400 500 m

1:10,000 @ A4

Projection: WGS 84 / Pseudo Mercator
Sources: Map data ESRI Satellite

These graphics have been produced as a result of information provided by the client and/or sourced by or provided to Ecology New Zealand Limited by a third party for the purposes of providing the services. No responsibility is taken by Ecology New Zealand Limited for any liability or action arising from any incomplete or inaccurate information provided to Ecology New Zealand Limited (whether from the client or a third party). The graphics are provided to the client for the benefit and use of the client and for the purpose for which it is intended.
© Ecology New Zealand 2017

McCulloughs Creek Hydropower Scheme

Supplementary Field Investigations

Date: 20 March 2019 | Revision : 1

Map prepared for No. 8 Ltd by Ecology New Zealand Ltd
Author: Marc Choromanski | Checked: C.Croft

APPENDIX C

Fish Survey Effort

ECOLOGY NEW ZEALAND

N

0 50 100 m

1:1500 @ A3

Projection: NZGD2000 / Mount Eden 2000
Sources: Map data ESRI Satellite

These graphics have been produced as a result of information provided by the client and/or sourced by or provided to Ecology New Zealand Limited by a third party for the purposes of providing the services. No responsibility is taken by Ecology New Zealand Limited for any liability or action arising from any incomplete or inaccurate information provided to Ecology New Zealand Limited (whether from the client or a third party). The graphics illustrate indicative extents and are provided to the client for the benefit and use of the client and for the purpose for which it is intended.
© Ecology New Zealand 2017

McCullough Creek, Hydroscheme

Location of Fish Survey within Lower Reach

Plan prepared for No 8 Limited by Ecology New Zealand Limited
Author: connor.whiteley@ecologynz.nz | Checked: MCh

APPENDIX D

Aquatic Features and Location of Cross Sections for 1D Modelling

ECOLOGY NEW ZEALAND

N

0 50 100 m

1:1500 @ A3

Projection: NZGD2000 / Mount Eden 2000
Sources: Map data ESRI Satellite

These graphics have been produced as a result of information provided by the client and/or sourced by or provided to Ecology New Zealand Limited by a third party for the purposes of providing the services. No responsibility is taken by Ecology New Zealand Limited for any liability or action arising from any incomplete or inaccurate information provided to Ecology New Zealand Limited (whether from the client or a third party). The graphics illustrate indicative extents and are provided to the client for the benefit and use of the client and for the purpose for which it is intended.
© Ecology New Zealand 2017

McCullough Creek, Hydroscheme

Location of Cross Section within Lower Reach

Plan prepared for No 8 Limited by Ecology New Zealand Limited
Author: connor.whiteley@ecologynz.nz | Checked: MCh

APPENDIX E

Freshwater Output Tables

Table 18 Results of Fishing effort detailing methodology of capture, amount caught and size distribution. Note UB = Un-baited trap, B = Baited trap.

	Koaro (mm)	Torrentfish (mm)	Longfin eel (mm)	Brown Trout (mm)
Gee 10 (UB)	100 - 150 (4)			
Gee 9 (UB)	140 - 150 (2)			
Gee 8 (UB)		110 (1)		
Gee 8 (B)	150 (1)			
Gee 7 (UB)	140 - 150 (2)			
Gee 7 (B)				
Gee 6 (UB)	180 - 200 (2)			
Gee 6 (B)	80 - 90 (2)			
Gee 5 (UB)	80 -140 (6)			
Gee 5 (B)	100 - 160 (4)			
Gee 4 (UB)				
Gee 4 (B)	160 (1)			
Gee 3 (UB)				
Gee 3 (B)	120 (1)			
Gee 2 (UB)	110 - 170 (3)			
Gee 2 (B)	100 (2)		300 (1)	
Gee 1 (UB)				
Gee 1 (B)				
Fyke 3				
Fyke 2	70 - 200 (16)		250 (1)	
Fyke 1	100 - 180 (11)	110 (1)		70 (1)
EFM 1	100 (1)	50 - 70 (4)		
EFM 2		65 - 75 (3)		
EFM 3	160 (1)			

Table 19 Cross section benthic substrate compositional break down

Cross Section	Boulder %	Cobble %	Gravel %	Fine Gravel %	Sand %
CS1	32.6	29.6	23.3	2.9	11.6
CS2	58.8	19.6	13.3	4.1	4.2
CS3	44.2	17.9	18.9	18.4	0.5
CS4	50	14.4	30	4.4	1.1
CS5	43.6	20	22.9	0	13.6
CS6	37.8	24.4	36.7	1.1	0
CS7	63.5	11	11	13.5	1
CS8	58.6	21.4	8.6	4.3	7.1
CS9	50	33.7	11.9	4.4	0
CS10	46.5	31.1	10.5	8.3	3.6
Reach	48	25.9	15.8	6.7	3.6

Table 20 Cross section water column habitat analysis percentage distribution.

Velocity (m/s)	0-0.2	0.2-0.4	0.4-0.6	0.6-0.8	0.8-1.0	1.0-1.2	1.2-1.4	>1.4	Total
Depth (m)	23.591	8.912	4.727	5.126	6.275	1.146	2.381	1.128	53.287
0-0.2	2.437	9.559	2.999	7.188	10.351	0.786	1.128	2.381	36.828
0.2-0.4	1.308	0.522	2.457	0.235	0	0.911	0.261	1.65	7.345
0.4-0.6	1.441	0.313	0	0.786	0	0	0	0	2.541
0.6-0.8	0	0	0	0	0	0	0	0	0
0.8-1.0	0	0	0	0	0	0	0	0	0
1.0-1.2	0	0	0	0	0	0	0	0	0
1.2-1.4	0	0	0	0	0	0	0	0	0
>1.4	28.777	19.306	10.183	13.335	16.625	2.844	3.77	5.159	
Total	23.591	8.912	4.727	5.126	6.275	1.146	2.381	1.128	53.287

Table 21 Cross section analysis of the reaches Area Weighted Suitability (AWS) and Calculated Habitat Suitability (CSI).

	1. Shortfin eel		2. Shortfin eel		3. Koaro		4. Torrentfish		5. Longfin eel		6. Longfin eel		7. Shortfin eel		8. Brown trout	
Cross Section	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**	**AWS (m2/m)**	**CSI**
CS1	5.219	0.433	5.219	0.433	3.934	0.326	3.632	0.301	0.67	0.056	5.858	0.486	0.715	0.059	7.779	0.645
CS2	3.693	0.48	3.693	0.48	0.971	0.126	1.181	0.153	2.904	0.377	3.287	0.427	2.312	0.3	2.226	0.289
CS3	4.731	0.541	4.731	0.541	0.879	0.101	0.648	0.074	2.069	0.237	3.699	0.423	1.891	0.216	3.026	0.346
CS4	3.463	0.487	3.463	0.487	1.917	0.27	2.244	0.316	1.286	0.181	3.852	0.542	1.395	0.196	4.046	0.569
CS5	3.701	0.539	3.701	0.539	0.475	0.069	0.534	0.078	2.392	0.349	1.968	0.287	2.554	0.372	1.574	0.229
CS6	3.348	0.423	3.348	0.423	1.621	0.205	2.282	0.288	1.714	0.216	3.163	0.399	1.709	0.216	2.502	0.354
CS7	1.712	0.306	1.712	0.306	1.605	0.287	0.904	0.161	0.592	0.106	1.684	0.301	0.744	0.138	2.623	0.468
CS8	4.86	0.547	4.86	0.547	3.484	0.392	3.561	0.401	0.967	0.109	4.066	0.457	1.089	0.123	5.304	0.597
CS9	2.663	0.314	2.663	0.314	4.447	0.524	2.873	0.339	0.001	0	3.296	0.389	0.031	0.002	5.09	0.6
CS10	7.27	0.603	7.27	0.603	5.635	0.468	4.511	0.374	0.86	0.71	7.368	0.611	1.554	0.129	9.39	0.779
Reach	4.1	0.465	4.1	0.465	3.227	0.366	2.604	0.295	0.931	0.106	4.1	0.465	1.108	0.126	5.172	0.586

Note: Species habitat selectivity has been derived for the following species from Habitat Use by New Zealand Fish and Habitat Suitability Models . (note 1:- Shortfin eel < 300mm, 2:- Shortfin eel < 300mm with cover, 3:- Koaro, 4:- Torrentfish, 5:- Longfin eel > 300mm, 6:- Longfin eel < 300mm, 7:- Shortfin eel > 300mm, 8:- Brown trout (< 100 mm))

Table 22 break down of all macroinvertebrates caught within the February 2019 field surveys.

Taxa	Species	MCI	MCI-sb	MCI 1	MCI 2	MCI 3	MCI 4	MCI 5	MCI 6	MCI 7	MCI 8	MCI 9
		score	score									
Deleatidium	*Deleatidium myzobranchia*	8	5.6	47	52	18	13	64	2		1	75
Nesameletus	*Nesameletus austrinus*	9	8.6	1	3	1						
Austroperla	*Austroperla cyrene*	9	8.4	3								
Megaleptoperla	*Megaleptoperla grandis*	9	7.3	2								
Zelandoperla	*Zelandoperla decorata*	10	8.9	13	1	1	1					1
Costachorema	*Costachorema sp.*	7	7.2		1							
Edpercivalia	*Edpercivalia maxima*	9	6.3	1	1							
Hydrobiosis	*Hydrobiosis sosor*	5	6.7	2								1
Hydrobiosis	*Hydrobiosis umbripennis*	5	6.7									1
Archichauliodes	*Archichauliodes diversus*	7	7.3									1
Elmidae	*Hydora nitida*	6	7.2	11	12	2	1	23			1	3
Hydrophilidae		5	8	2								
Aphrophila	*Aphrophila neozelandica*	5	5.6	1								
Austrosimulium	*Austrosimulium australense*	3	3.9	1								
Blephariceridae	*Neocurupira hudsoni*	7	7	1			1		1			
Eriopterini		9	7.5			2		1				
Maoridiamesa		3	4.9									1
Orthocladiinae	*Eukiefferiella sp.*	2	3.2					3		3		
Polypedilum		3	8								1	
Sciomyzidae	*Neolimnia sigma*	3	3					1				
Tanypodinae tribe Macropelopiini		5	6.5								1	
Potamopyrgus	*Potamopyrgus antipodarum*	4	2.1	1								

Number of Taxa				13	6	5	4	5	2	1	4	6
EPT Value				7	5	3	2	1	1	0	1	3
Number of Individuals				86	70	24	16	92	3	3	4	83
% EPT				80.23	82.86	83.33	87.50	69.57	66.67	0.00	25.00	93.98
% EPT Taxa				53.85	83.33	60.00	50.00	20.00	50.00	0.00	25.00	50.00
Sum of recorded scores				89.00	49.00	42.00	31.00	28.00	15.00	2.00	22.00	39.00
MCI Value				136.92	163.33	168.00	155.00	112.00	150.00	40.00	110.00	130.00
Sum of abundance load				674.00	541.00	193.00	127.00	668.00	23.00	6.00	22.00	648.00
QMCI Value				7.84	7.73	8.04	7.94	7.26	7.67	2.00	5.50	7.81
Sum of recorded scores				85.60	43.80	37.80	28.70	26.50	12.60	3.20	27.30	40.60
SBMCI Value				131.69	146.00	151.20	143.50	106.00	126.00	64.00	136.50	135.33
Sum of abundance load				560.80	425.80	147.70	95.90	544.10	18.20	9.60	27.30	476.10
QMCI-sb Value				6.52	6.08	6.15	5.99	5.91	6.07	3.20	6.83	5.74

APPENDIX F

Tree Removal Protocol

APPENDIX 1: TREE REMOVAL PROTOCOL

Protocols for determining presence of bat roosts and subsequent tree felling protocols if authorised

1. Introduction

The protocol aims to:

1. Provide clear, concise procedures that are to be followed prior to removal of all trees along the alignment, with the goal of avoiding mortality or injury to long-tailed bats during the tree removal process; and

2. To locate long-tailed bat colonial (and where possible, solitary) roost trees that exist within the alignment prior to removal.

There are three protocols that will be used:

Protocol A: Identification of Potential Bat Roost Habitat;

Protocol B: Pre-Felling Procedures; and

Protocol C: Bat Injury or Mortality

2. Roost Tree Features and Definition

2.1 High Risk Trees

For the purposes of this protocol, trees offering High Risk potential as bat roosts are defined as being >15cm DBH, and will have one or more of the following features:

- Cracks, crevices, cavities and/or fractured limbs large enough to support roosting bat(s)
- Sections of loose flaking bark large enough to support roosting bat(s)
- A hollow trunk, stem or branches
- Deadwood in canopy or stem of sufficient size to support roost cavities or hollows
- Bat droppings, grease marks and/or urine staining around cavities

2.2 Low Risk Trees

Trees with evidence of bat droppings, grease marks and/or urine staining around cavities should be noted and investigated as probable roost trees regardless of size. However, all trees <15cm DBH that lack such obvious sign of bat roosting may be felled immediately, without the need for further assessment or monitoring, and without the need for an Approved Bat Ecologist to be present.

2.3 Dusk & Dawn Definition

For the purposes of this protocol Dusk and Dawn are defined as official civil dusk and dawn times.

2.4 Bat Ecologist Definition

1. Only people certified as competent Bat Ecologists can operate under this Plan.

2. There are 5 levels of competency:
    - Level 1 - competent at setting up Automatic Bat Detector Monitoring Systems (ABMS).
    - Level 2 - competent Level 1 plus experienced at analysing and interpreting the ABM results.
    - Level 3 - experienced at finding and identifying long-tailed bat roost cavities that are either occupied or unoccupied.
    - Level 4 - competent at Levels 1-3 as well as catching and handing bats, as outlined in Pages 58-108 of the Department of Conservation Best Practice Manual of Conservation Techniques for Bats Version 1.0 (Sedgeley *et al.* 2012 - http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-bats/im-toolbox-bats-doc-best-practice-manual-of-conservation-techniques-for-bats.pdf).
    - Level 5 – Trainer; competent at Levels 1-4 plus capable of training staff at all levels and certifying competence at Levels 1-4.

3. Competency can be certified by the Leader of the Department of Conservation Bat Recovery Group (Colin O'Donnell) or any other Level 5 Bat Ecologist.

4. Only personnel certified at the appropriate level may undertake tasks in the tree felling protocol. Thus only personnel at level 3 or above are certified to undertake tree roost inspections and make decisions about whether a potential roost is deemed occupied (not allowed to be felled) or unoccupied (allowed to be felled).

5. In the case of felling a bat roost accidentally, whereby bats are injured or dislodged and capable of being caught, and if a Bat Ecologist (Level 4 or 5) are not available to handle the bat, the attending personnel must carefully place the bat or bats in cloth capture bags following guidance in the DOC Best Practice Manual (pages 154-155) and take them to the authorised (vet?) described in Protocol C.

3. Protocol A: Identification of Potential Bat Roost Habitat

1. All trees (individuals and stands) to be removed along the entire alignment will be surveyed and assessed prior to tree removal as either High Risk or Low Risk in terms of providing potential bat roost habitat by the project team.

2. All High risk trees shall be subjected to pre-felling assessment as per Protocol B. Pre-felling tree assessments and acoustic monitoring (see Protocols B for details) shall be undertaken by an appropriately qualified and experienced ecologist (Approved Bat Ecologist) approved by DOC.

3. All Automated Bat Monitor (ABM) data gathered during pre-felling survey shall be reviewed the same morning the survey specified in Protocol B ends. All data must be reviewed on the same day giving the tree fellers sufficient time to fell trees prior to dusk if no bats are recorded.

4. Protocol B: Pre-Felling Procedures

1. High Risk trees will only be removed between October 1st and April 30th. No High Risk trees will be felled outside this period unless prior permission is obtained from DOC and WRC.

2. All Low Risk trees may be felled at any time without the need for acoustic survey.

3. The Approved Bat Ecologist should be on site for removal of all High Risk trees. The Approved Bat Ecologist is not required to be present for removal of Low Risk trees but should be available if their presence becomes necessary due to discovery of bats.

4. All High Risk trees or areas of High Risk trees to be removed will be clearly marked by the Approved Bat Ecologist in advance of removal. To determine roosting, High Risk trees will be acoustically monitored with ABMs overnight (between 1 hour before official dusk to one hour after official dawn) for a minimum of two consecutive nights where overnight weather conditions meet the following criteria:
   - (i) Air temperature does not drop below 7 degrees Celsius from sunset until four hours after sunset;
   - (ii) Mean overnight wind speed does not exceed 20 km/h;
   - (iii) Maximum overnight wind gust does not exceed 60 km/h; and
   - (iv) Rainfall of no more than 2.5mm in the first 2 hours after dusk.

5. No monitoring shall take place during full moon, or 1 night either side of full moon. Where a night of monitoring is lost to adverse weather or presence of a full moon, further monitoring must take place until two consecutive nights of monitoring is achieved, with no bats detected.

6. Where existing monitoring data indicates that roosting bats may be present, the Approved Bat Ecologist may decide not to undertake monitoring but to assume roosting bats may be present. In this case the procedure described in item 10 below will be adopted, with each High Risk tree to be felled being assessed for bat roosts. However, under these circumstances, the Approved Bat Ecologist may decide to undertake selective monitoring, such as within the canopies of large emergent trees, to assist in the assessment process.

7. High Risk trees in the wider landscape will be monitored with ABMs placed appropriately as determined by the Approved Bat Ecologist.

8. All Automated Bat Monitor (ABM) data gathered during pre-felling survey shall be reviewed the same morning the survey specified in Protocol B ends. All data must be reviewed on the same day giving the tree fellers sufficient time to fell trees prior to dusk if no bats are recorded.

9. If no bats are sighted or detected during two consecutive nights of valid ABM monitoring, the Approved Bat Ecologist shall inform the Construction Site Manager or Environmental Manager within 1 hour of reviewing the data to give permission for the affected tree(s) to be felled.

10. If bat activity patterns suggest the possibility that bats are roosting in the vicinity of the ABM, or if a bat roost is observed, the Approved Bat Ecologist shall inform the Construction Site Manager or Environmental Manager within 1 hour after reviewing the data or of observing the roost that the affected tree(s) cannot be felled until further investigations of the trees have been undertaken. If considered appropriate by the Approved Bat Ecologist, likely roost trees will be climbed by an arborist under direct supervision of the Approved Bat Ecologist. Utmost care must be taken not to disturb any roosting bats. Photographs must be taken of any roosts or roost evidence found. A hand-held acoustic device and if necessary an endoscope will be used to examine cavities suspected of housing bats. If climbing is not considered appropriate, the tree or trees may be observed with a thermal imaging camera over two consecutive valid nights (as described in Condition 4 above), to observe bats leaving or entering a roost within the tree or group of trees. If the check or observation reveals no roost is present, the Construction Site Manager or Environmental Manager will be informed by the Approved Bat Ecologist that the tree can be felled on the day of climbing inspection or the day following nocturnal thermal observation.

11. If bats are confirmed to be roosting within the tree, it will not be removed until further monitoring confirms that the bats have abandoned the roost. The following actions will be taken:
    a) The immediate area will be cordoned off with safety fencing and signage erected in a 10m radius around the roost, alerting any person approaching the area that a bat roost is present and to stay clear.
    b) The existence of the roost will be widely publicised to all construction staff and work instructions for the immediate area will be updated to reflect the presence of the roost and the measures to minimise disturbance.
    c) All adjacent construction activities (within 100m) will be assessed for noise and vibration and where in the opinion of the Approved Bat Ecologist the method of construction may disturb the roost, steps will be taken to eliminate, isolate, or minimise the disturbance wherever possible.
    d) No work will take place within 100m of the roost from 1 hour before official dusk to 30 minutes after official dawn unless approval is given by DOC and the WRC & WDC.

12. Roost trees should be clearly marked and all relevant staff briefed to ensure the tree is not removed. Acoustic monitoring will continue until the roost is no longer occupied by bats, as evidenced by two consecutive valid nights of monitoring where bats are not detected, or visual inspection.

13. If bats are still roosting in the tree after 7 nights, the Approved Bat Ecologist will contact the Construction Site Manager or Environmental Manager, and a meeting or teleconference held within 3 days to decide an appropriate way forward. Appropriate measures may include sectioning the tree and relocating the bat roost once bats have vacated.

14. Any High Risk trees felled will be inspected for bat roost sign by the Approved Bat Ecologist following felling.

5. Protocol C: Bat Injury or Mortality

5.1 Handling of dead and / or injured bats

1. Any living bats found during felling will be taken to a vet immediately for assessment. Bats will be placed in a cool dark material-lined box or cotton bag by or under the direction of the Approved Bat Ecologist to ensure the animal is handled appropriately.
2. DOC should be contacted no longer than 2 hours after an injured or dead bat is found.

3. Any bat that is found dead or injured and subsequently euthanised must be stored in a fridge at less than 4°C and be returned at the soonest available time to:
   The Wildlife Act requires that in the first instance the bat is returned to DOC.

4. Once the vet has made an assessment the Approved Bat Ecologist and vet shall forward to the Grantor for approval a recommendation for release; or rehabilitation and the longer term future for the bat/s for approval by the Grantor.